Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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On the Chicago, Milwaukee & St. Paul Railway

The first steel train to be operated between Chicago and Puget Sound was run on the Chicago, Milwaukee & St. Paul, and the Chicago, Milwaukee & Puget Sound Railways. So popular did it immediately become that there are now two trains daily, known as "The Olympian" and "The Columbian."

The new railway throughout is as thoroughly well constructed as the best engineering knowledge, experience and skill, backed with unlimited capital, could make possible, and holds the record for rapidity in railroad construction, the entire 1,400 miles having been built in the remarkably short period of less than three years. The service on the "The Olympian" so nearly attains perfection that even the most fastidious and discriminating American traveler finds his every want supplied almost before he realizes its existence. "The Columbian" is also a steel-constructed train from end to end, offering the same high excellence of service as "The Olympian" and with the latter provides unequaled double daily service on the only steel trains to and from the Pacific Northwest.

The locomotives, of which there are 1,957, are nearly all of recent construction, a large number being added during the last two years. The trains are steel constructed from end to end, and are not surpassed in point of substantial construction or elegant finish by anything in the world. Of the 7,512 miles of track already in operation, the roadbed will compare favorably with the best of the Eastern roadbeds. Numerous steel bridges span the many rivers crossing the route, the largest being that at Mobridge in South Dakota, where the track crosses the Missouri River. Our illustration shows one of the numerous smaller bridges which are all of steel, resting on concrete piers. Of these there are a large number in that position of the track passing through the Bitter Root Mountains, where, in spite of the great natural difficulties, an eveness of grade has been maintained in the greater portions of the road at all seasons of the year. The scenery is of the most gorgeous kind, varied with endless regions of timber-covered slopes, cliffs, canyons and glaciers, interspersed by mountain streams and lakelets, which are rapidly becoming to be observed as the wonderland of the West, and bid fair to outrival the panoramic splendors of the old world.

CLEAR CREEK BRIDGE, BITTER ROOT MOUNTAINS, CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

ELECTRICAL APPLIANCES ON THE PANAMA CANAL—

Phenomenal Centralized Control System for the Canal Locks

The electrical specification, design and manufacture of the Panama Canal centralized control system may properly be regarded as one of those undertakings which, from an engineering standpoint, not only arouses a lively interest but also presents an opportunity for much valuable instruction. The interest results mainly from the immensity of the canal project itself, and the instruction from a consideration of the methods employed to insure the passage of even the largest ships afloat across the isthmus with speed and safety. The complete operation of the canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama Railroad, the electrification of which is under contemplation.

The specifications for the entire generating, lock controlling and distribution system for operating the Panama Canal were prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission.

GENERATION AND DISTRIBUTION.

The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lock control, is composed of:

A 7,500 kv-a, 2,200 volt hydroelectric power plant at the Gatun Dam;

A 4,500 kv-a, 2,200 volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work;

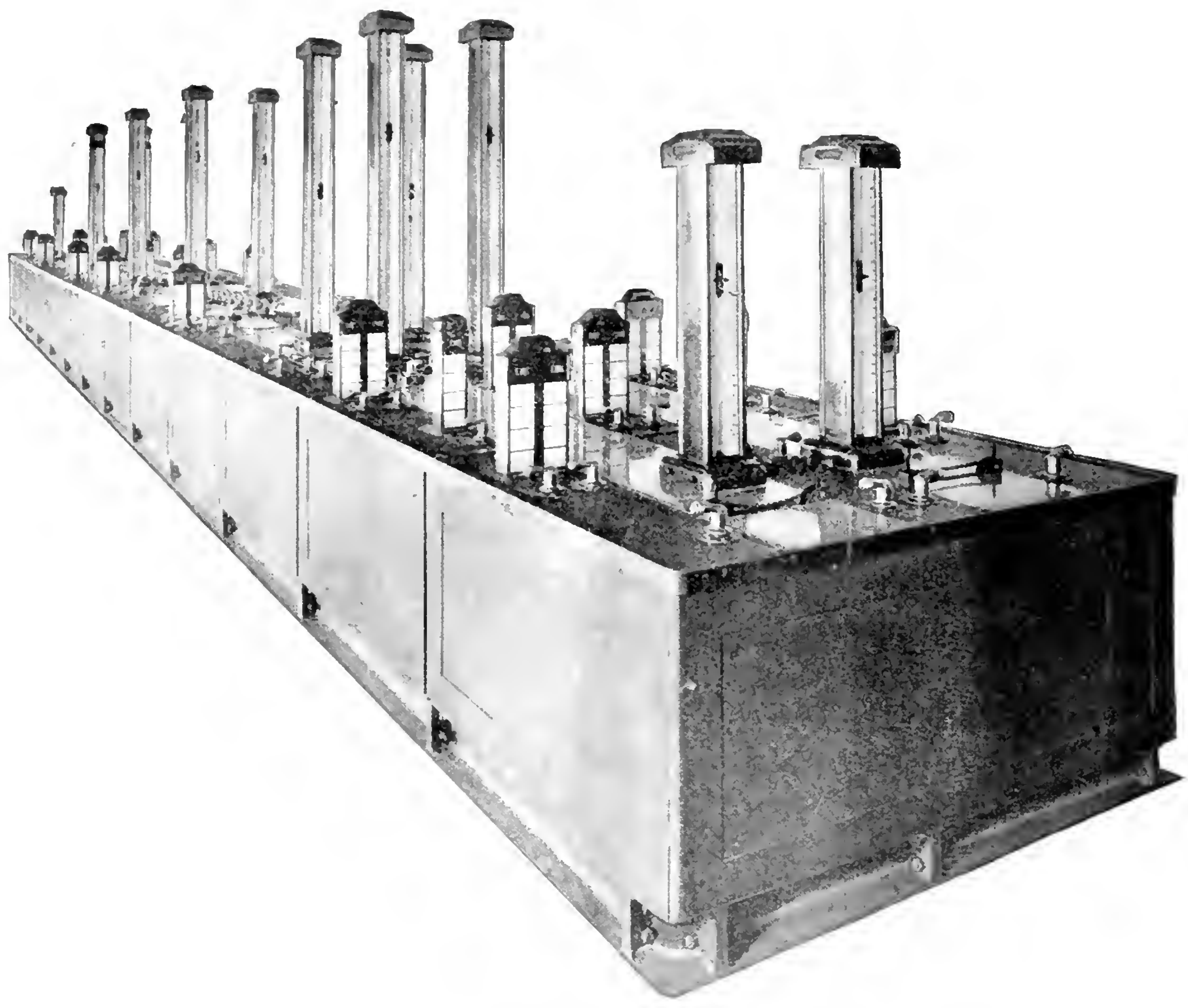
A double 44,000 volt transmission line across the isthmus, connecting Cristobal and Balboa with the two power plants;

Four 44,000-2,200 volt substations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power;

Thirty-six 2,200-240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks;

Three 2,200-220-110 volt transformer stations for the control boards at the locks;

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.



CENTRALIZED CONTROL BOARD FOR MIRAFLORES LOCKS.

POWER SUPPLY AND CONTROL PANELS FOR LOCK MACHINERY MOTORS.

Current for the lock machinery and towing locomotives is transformed from the 2,200 volt system in the immediate vicinity of where it is used. There are a total of thirty-six transformer stations for all locks.

To give an idea of the number and

sizes of motors to be controlled in operating the lock machinery, the following table is interesting:

Machines and Operation.	Motors each Machine and H. P.	Number of Motors. Gatun.	Ped. M.	Mira.	Total.	Total Horse Power.
Miter gate, moving, each leaf...	1—25	40	24	28	92	2,300
Miter gate, miter forcing.......	1— 7	20	12	14	46	322
Fender chain, main pump......	1—70	16	16	16	48	3,360
Fender chain, operating valve..	1— ½	16	16	16	48	24
Rising stem gate valve.........	1—40	56	24	36	116	4,640
Cylindrical valve	1— 7	60	20	40	120	840
Guard valve	1—25	6	6	6	18	450
Auxiliary culvert valve.........	1— 7	4	4	4	12	84
Totals		218	122	160	500	12,020

There are many motors not included above, as, for instance, those for the spillway gates, for the hand rails on the mitering gates and for the sump pumps. The spillway gates are remote controlled from a special control board, and the control of the hand rail motors is given in connection with the discussion of mitering gates.

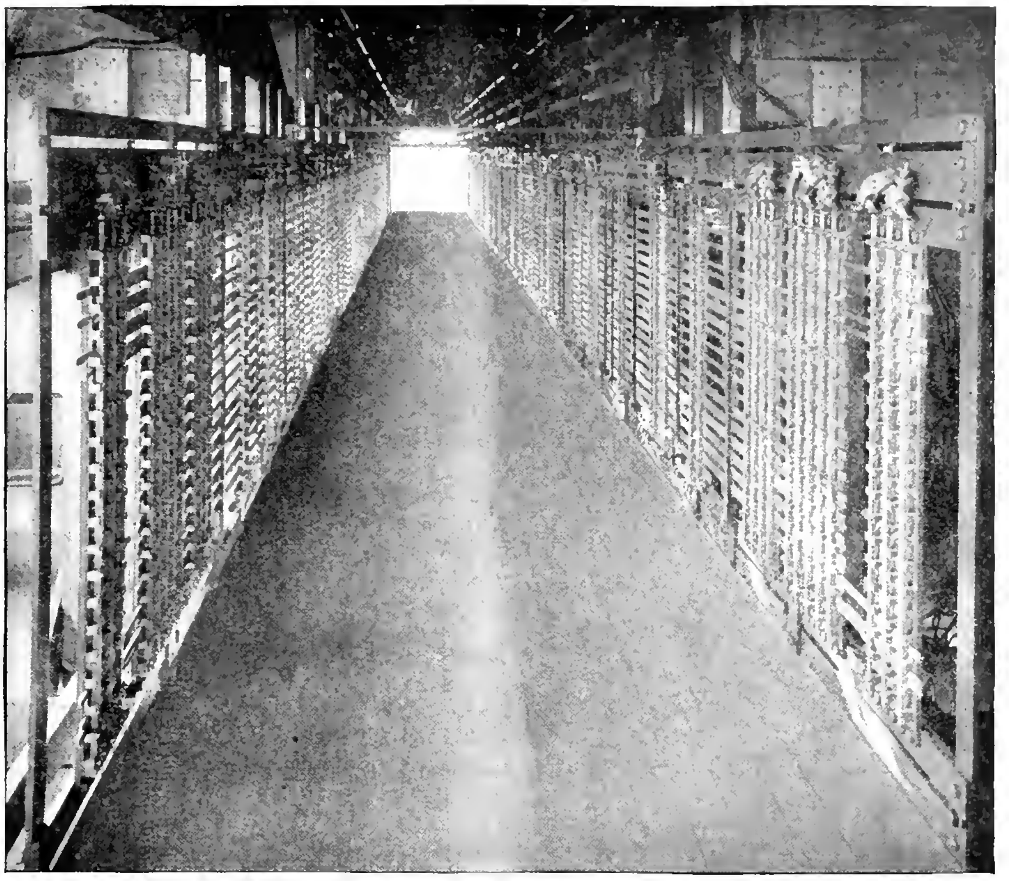
The motors are started and controlled by contactor panels located near them, the contactors of which handle the main motor currents. These contactors are controlled from the central control house. The smaller motors, including those for cylindrical valves, auxiliary culvert valves and miter forcing, are started by being thrown directly on the line. Two double-pole contactors are used, one for forward and one for reverse. In the case of larger motors for miter gate moving, rising stem valves and guard valves, a starting point with resistance in two legs of the three-phase circuit is provided.

In all cases the contactors are operated from the control boards—to be described later—by three wires, one for forward, one for reverse and a common return. In the case of panels having a starting point, the period during which the motor remains on the resistance is automatically controlled by a dashpot, so that the starting operation at the control house is the same, simply energizing a forward or reverse wire as the case may be. The control connections are arranged in such manner that each individual machine may be controlled locally. This arrangement provides for emergency operation should the control circuits from the central control house be out of order.

LOCATION AND OPERATION OF LOCK MACHINERY.

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space for maneuvering ships and protecting the apparatus from the weather without erecting numerous houses.

The mitering gates consist of two massive leaves pivoted on the lock walls which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates, at lake and ocean ends are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in this position by a device called a miter forcing machine.

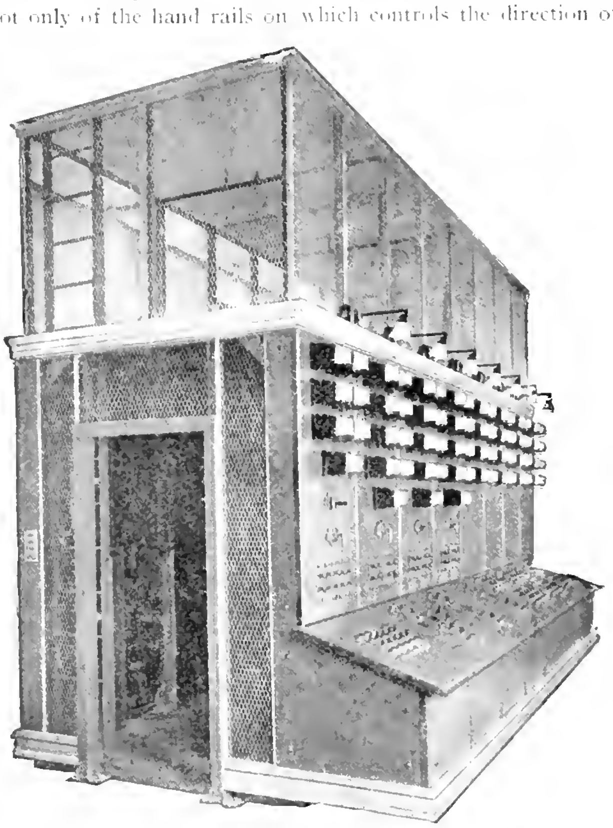


INTERLOCKING SYSTEM BELOW THE MIRAFLORES LOCKS.

On the top of all mitering gates a foot

walk with hand rails is provided. When the gates are opened and in the recesses provided for them in the lock walls, these hand rails would interfere with the passing of the towing locomotives, except in the case of the lower guard gates. The hand rails are therefore made to be raised and lowered. This is done by a motor under the foot walk, controlled from the lock wall. Near the approach to each foot walk a controller is located in the lock wall flush with the surface, this controller being operated by a foot push. If the gates are closed and the hand rails are down, and it is desired to cross on the gates, the foot push is pressed and the hand rails are raised by their motors. This is true not only of the hand rails on the nearer gate leaf, but of the hand rails on the farther leaf as well. After passing across, one can, if one desires, press the foot push on the other side and both hand rails will be lowered. Or, if one leaves the hand rails up and the gates are opened by the operator in the control house, they will be automatically lowered so as to be out of the way when the gate is in the recess. When the gates are again closed, the hand rails will automatically rise again if the foot controller has been operated in the mean time. The hand rails cannot be raised when the gates are opened, and no harm results if the foot switch is operated while the gates are in the closed position.

The chain fenders are stretched across the canal in front of all mitering gates which can be exposed to the upper lock level and also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed, and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain, the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed is accomplished by two motors; one driving the main pump supplying water under pressure, and the other operating a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.



200 VOLT A. C. INSTRUMENT AND CONTROL BOARD.

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are located in the culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts, under the lock chambers and up through openings in the lock floors.

The rising stem valves are installed in pairs, and each pair is in duplicate; also each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve and makes it more easily operated, each valve being 8 by 18 feet. One pair of duplicates is left open as a guard, or reserve pair; the other pair is used for operating, so that in case of an obstruction in the culvert or accident to the machinery, the duplicate pair can be used.

At the upper ends of the culverts at the side walls, the duplication is accomplished by three valves in parallel, called the guard valves. They perform service exactly similar to the rising stem valves, except that three valves in parallel in this case must conform to the same laws as the two in parallel in the other case.

The culvert in the middle wall must serve the locks on both sides, and to control this feature cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks there are two valves in the side wall for regulating the height of water between the upper gate and upper guard gate, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lake. These valves are called the auxiliary culvert valves.

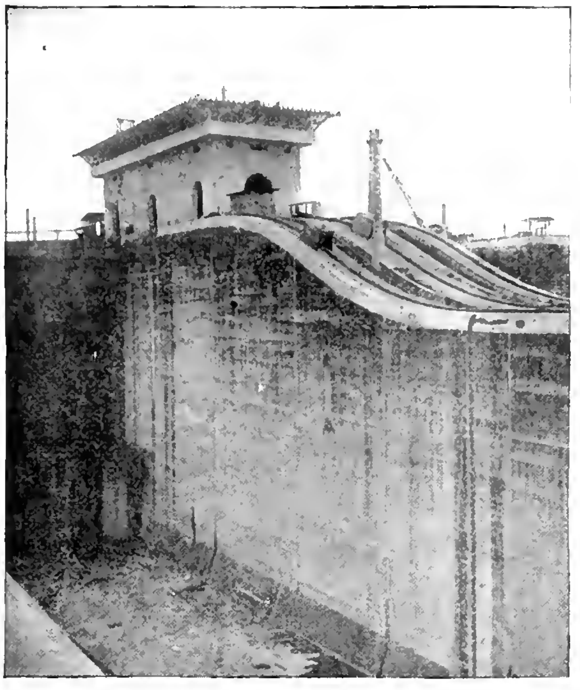
REASONS FOR USING THE CONTROL SYSTEM ADOPTED.

As the flight of locks at Gatun, for instance, extends over approximately 6,200 feet, and the principal operating machines are distributed over a distance of about 4,000 feet, it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invariably been the practice heretofore. Such a force would be difficult to co-ordinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number of operators, operating expense, and liability to accident. To accomplish this system of control, a control board for each lock was constructed which permitted having all control switches located thereon mechanically interlocked so as to minimize, if not entirely prevent, the errors of human manipulations.

CENTRALIZED CONTROL AND INDICATING SYSTEM.

The control boards are installed in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other apparatus, as all are pro-

vided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves, and are arranged with indicating devices which will always show the position of valves, lock gates, chains and water levels in the various lock chambers; and with the exception of such machinery as needs only an "open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.



RISING STEAM VALVE INDICATOR.

The indicators on the Panama control boards were developed especially for this undertaking, and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point.

CONTROL BOARDS REPRESENT LOCKS IN MINIATURE.

The control boards are of the flat top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun	64 feet
Pedro Miguel	36 feet
Miraflores	52 feet

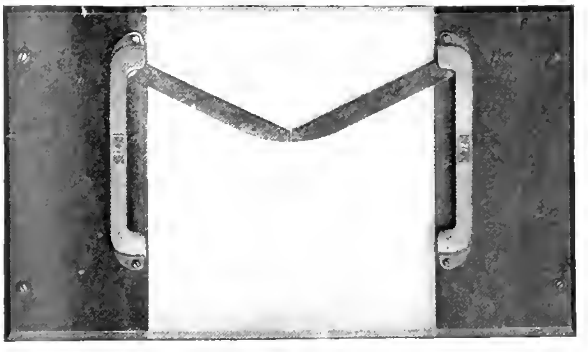
The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs. The outer edge of the board is surrounded by a brass trim rail, and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90 degrees. They are provided with nameplates for the "open," "closed" and "off" positions. The space immediately below the flat top of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, synchronous receivers and their cable connections. Connection boards are provided for the cables, which are led up from each side, as are busos for supplying current to the control switches, receivers and the lamps that illuminate the scales of indicators.

MECHANICAL INTERLOCKING SYSTEM.

In order to make it necessary for the operator to maneuver the control switch handles always in a certain order, corresponding to a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with interlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switchboard operator stands. The latter floor does not extend across under the board, this space being open so that all parts on the underside of the board are accessible from the floor below.

Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks. The interlock system is essentially a bell crank mechanism, connecting the shaft of the control switch through a movable horizontal bar to a vertical operating shaft which can or can not move according to the relative positions of the interlocking bars and dogs. The interlocking rack is a steel frame carrying five horizontal members. Upon these and tying them together are vertical steel straps which carry brass runway posts for the vertical and horizontal interlock bars. These posts are riveted to the vertical steel straps, a thin brass plate between posts and straps making the runways non-corrosive. The vertical operating shafts are of square steel turned on the ends and work in brass bearings near top and bottom of the interlocking rack. Forked cranks mounted on the vertical operating shafts move the horizontal interlock bars by means of pivot blocks set over pin blocks riveted to the horizontal bar. The interlock bars and dogs are of special shape hard extruded brass, which section



MITERING GATE INDICATOR.

keeps the dogs in line with the axis of the bars when under pressure by being engaged with another dog on a vertical bar. Every control switch uses a horizontal bar of from 3 to 50 feet long.

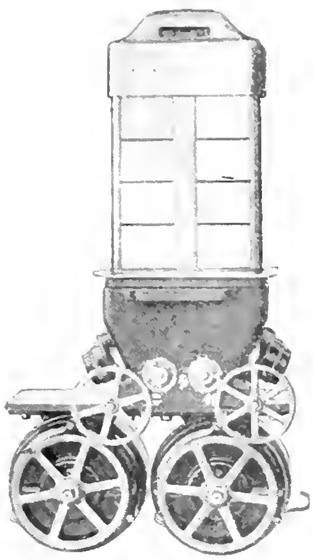
The interlock system depends mainly on the action of engaging bevel dogs located on horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar can not be moved without raising a vertical bar. Thus if at any time a dog on a horizontal bar rests

against the upper end of a dog on a vertical bar, no movement of the horizontal bar where the dog engages with the vertical bar can take place, and the control handle connected to that particular horizontal bar is locked.

Interlocks prevent the chain fender from being lowered until adjacent mitering gates have been opened, and also prevent the gates being opened until the chain is in the raised position.

Also the rising stem valves of the side wall, next above or below a miter gate, must be closed while the miter forcing machine is open. As the miter forcing machine cannot be closed until the gates are closed, this means that the valves either above or below the gate must remain closed until the gate itself is closed, thus preventing the operator from creating a current of water around the gates while they are open, or being moved in opening or closing.

Either pair of rising stem valves may



RISING STEM VALVE INDICATOR.

be opened first, at the choice of the operator, an interlock becoming effective when the first valve of the second pair of duplicates is opened. To illustrate this operation, consider, for example, a side wall culvert at Gatun with its principal rising stem valves at each change of level from one lock to the next. The control of these valves is interlocked so that if the valves are opened at one particular point, the valves a lock length upstream or downstream cannot be opened. Thus the operator is limited to equalizing the water between locks and cannot allow water to flow from the upper lock past the middle lock into the lower lock, which operation, if permitted, might flood the lower lock walls and the machinery chambers in them. The cylindrical valves are interlocked so that if those on one side are opened the ones on the other side are locked closed, and the opening of one switch on a side will lock the opposite ten. This prevents careless cross filling between locks, which operation might be combined with the regular method and produce flooding. However, there may be times when it is desirable to employ cross filling to economize in the use of water from Lake Gatun in the dry season. For this reason this interlock is made removable by the use of a Yale lock and key. The key will be placed in the hands of the chief operator.

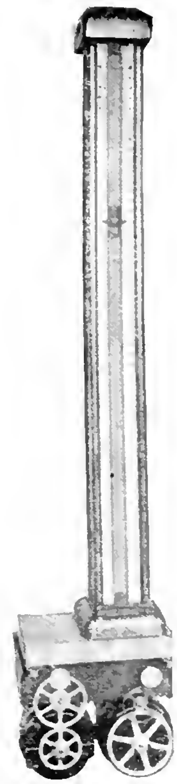
In the use of the middle wall culvert, the cylindrical valves on one side or the other must be opened before the rising stem valves can be opened, and the rising stem valves must be closed first. This interlock is applied in order to require the operator to control the flow of water by means of the rising stem valves rather than by the cylindrical valves.

In most cases the locks are divided into two unequal parts by the intermediate mitering gates. This arrangement makes it necessary to divide the ten cylindrical valves into two groups of seven and three, respectively, for the long and short lengths. A selecting lever is provided for these interlocks and may be set as indicated by a nameplate on the lever to "three," "seven" or "ten" respectively; whereupon the corresponding valves are subject to that interlock, and the others of the group of ten are locked closed if three or seven only are to be used. The failure of the operator to make his selection properly in advance will simply cause him the trouble of going back and doing so, as the remaining valves are locked closed. This arrangement permits handling small vessels without causing waste of water due to operating such vessels in the large chambers. If a short vessel were being passed downstream, it would first pass into the chamber having three cylindrical valves. The group selective lever would then be placed on the "three" position which would permit the opening of three valves above the intermediate gate, but would lock closed the other seven valves above it. After the vessel had been passed below the gate the handle may be reversed releasing the lever and locking three switches.

There are intermediate rising stem valves in the side walls at each intermediate gate, but no interlocks are applied to these for the reason that they will be used in a more or less irregular manner, and no fixed laws for their operation can be made in advance. Moreover, they control the water only between different sections of the same lock, and there is not the danger from mistakes in operation which exists in the case of the other valves which control water between lock levels. The same is true of the small auxiliary culvert valves, by means of which the space between the upper guard gate and upper main gate is filled and emptied.

In case a large vessel is to be locked through, the interlocks on the intermediate gates can be made ineffective by the operation of a Yale lock which uncouples a clutch and disconnects the central switch from the operating mechanism. Turning the key removes the interlock and permits the intermediate gates to be thrown open to obtain a 1,000-foot level and the valves operated independently of these gates.

To obviate the possibility of flooding the locks when valves are in a certain position, diagonal interlocking is introduced between the rising stem valves of the side wall and those of the middle wall a lock length away. This interlocking between valves diagonally across a lock when the cylindrical valves are open is needed to prevent the flow of water from,



WATER LEVEL INDICATOR.

say, the upper lock by way of a side wall culvert to the middle lock, thence by way of the middle wall culvert to the lower lock, thus allowing an operator through carelessness to flood the lower lock walls. If the cylindrical valves of a certain lock are closed, the interlock is not needed on the rising stem valves of that lock; and since such interlock would interfere with the proper use of the valves of its twin lock on the other side of the middle wall, this interlock is automatically removed when all ten cylindrical valves are closed on the particular lock in question, and is automatically applied again if one or more of the ten cylindrical valves are opened. Furthermore, the valves of the side wall immediately at the gate which is being moved will be open to equalize water level, and diagonal interlocking will

prevent the opening of the middle wall valves a lock length above or below the gate being moved. Each of the four valves of such a group has independent control, their control switches being so interlocked that either pair may be opened and left open as guard valves, the interlocks becoming effective when the operator tries to open the first valve of the second pair. In addition to these pairs of valves in parallel, each pair is duplicated at each change of level from one lock to the next.

SPECIAL CLIMATIC REQUIREMENTS.

To withstand the humid atmosphere of the Isthmus, every insulated part, such as solenoid, relay, circuit breaker and other coils, was impregnated with non-hygroscopic compounds. All small parts were made either of brass, copper, Monel metal, bronze or of sherardized iron or steel. Mica and treated asbestos lumber were used largely in place of fibre or wood.

EDWARD SCHILDHAUER,
Electrical and Mechanical Engineer.

All of the lock machinery motors, control panels, centralized control boards, power station generating apparatus, switchboards, transmission line substation equipments, coaling stations, and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine shops were manufactured by the General Electric Company.

Seasoning Timber by Electricity.

A process of seasoning timber by electricity has been invented by a European scientist, Dr. Nodon. He claims that his process can be applied in the forest where the trees are felled, says the London *Electrical Review.* The process depends on the electrolysis of cellulose and its derivatives. The newly-felled trees are sawn into thick planks and laid on a false flooring, one on top of the other, with the interposition, however, of moistened matting or similar material, between each layer, to act as electrodes for the introduction of alternating current, which is passed for ten hours or more. The effect of the current is to produce chemical changes in the cellulose and the sap, rendering them impervious to decay. Further, the sap loses those gummy and hygroscopic characteristics which normally prevent rapid drying. It is claimed that timber thus treated is ready for use a few weeks after it is felled, and is harder, stronger, more homogeneous, easier to work and less warped by moisture than timber which has been seasoned by the ordinary air-drying process.

Another Advantage of Electric Motor Drive.

The United Oil Company has reduced the cost of operating its property in the Midway oil fields, California, 37.5 per cent. by substituting electricity for steam. Eight pumping motors have been installed. A study of costs shows that a saving of 86.2 per cent. has been made for water, 46.2 per cent. for oils and grease, 13.5 per cent. for fuel oil, and 8.6 per cent. for labor. This saving has attracted the attention of other oil companies, and electricity will be used to a much greater extent in the future.

Empty and Load Brake.

The Westinghouse "empty and load" brake, illustrated and described in the July and August, 1912, issues, appears to be giving very satisfactory service in certain parts of the country under the conditions that led to its design.

A certain road handling heavy cars on a 2½ per cent. grade was unable to safely drop 27 loads of 50 tons each, down the 16½-mile grade with the standard freight brake, even with one hour and thirty minutes' time permitted.

When the "empty and load" brake was applied to these cars, number of cars in train was increased to forty, the load from 50 to 62 tons each car, and the train had to be brought down in less than 1 hour 10 minutes' time to keep from stalling, and at that a reduction of more than 5 lbs. results in stalling. Only 10 lb. retaining valves are used, and the problem before the air brake company is to devise some means of using this brake intact without stalling the train.

It is very gratifying to know that an efficient freight car brake is in service, and the air brake men should be jubilant enough to recommend the use of a Mallet to push the train down the hill or to use the brakes alternately, cutting out one-half each trip until such time as severity of service equals the capacity of the brake.

The Interurban Railways.

The Interurban Railway is playing an important part in the growth of this country. If one will look at a map of Ohio, Michigan and other Middle West States, on which are shown the electric railways, he will be greatly surprised at the number and mileage of these roads. In fact, they form a thick network over the whole State. These electric railways cover sections remote from the steam railroads and bring about a development of the country.

Many of these roads are run at high speeds, and, moreover, have luxurious equipment. One of the many important roads is that of the Kansas City, Clay County & St. Joseph Railway, which operates on 1,200 volts direct current. The road is a high-speed short-route between Kansas City and St. Joseph, a distance of 52.42 miles, which is operated on 70 minutes headway. As much care is given to the roadbed of these high-speed electric roads as to many steam railroads, stone ballast being used extensively.

Canadian Electric Railways.

From a report issued by the Canadian government appears that there are in operation 1,308 miles of electric railways of the first class main track; second class, main track, 295 miles; siding and turnouts, 121 miles. Total single track, 1,724 miles. The capital involved is $122,841,-946. The revenue collected for the year was $23,499,250, while the working expenses for the year were $14,266,674. The additions made to the capital during the last five years approached $50,000,000.

Firing a Locomotive and Tender.

In the early days of railway operating in England, what was called a "deodand" was inflicted upon railway companies for the purpose of aiding people who suffered from railway accidents. It is related that on the Great Western Railway of England an accident, due to a landslide, happened, and eight passengers were killed. The coroner's jury returned a verdict of accidental death, and at the same time inflicted a "deodand" of 100 pounds to be levied upon the locomotive and tender.

This practice of levying a deodand in cases of railway accidents resulting in loss of life, affords a curious illustration of how seldom accidents causing loss of life must have happened in the pre-railway times of travel. The mere mention of it now as ever having existed sounds almost as strange and unreal as would an assertion that the corporations had in their earlier days been in the habit of settling their differences by wager of battle. Like the wager of battle, the deodand was a feature of English common law derived from the feudal period. It did not exist in Scot or Welsh law.

General Correspondence

Justice for the Railroads.

EDITOR:

For some time past, a number of eminent railroad men have been engaged in an endeavor to secure fair treatment for the properties which they represent, and for whose management they are responsible.

Thus far, their efforts have not met with much success. What, then, is the reason for this failure to obtain justice for the greatest industry in America today?

My reply, based on experience and observation extending over a period of more than fifteen years, is that the daily press is the source of most of the trouble. Railroad men justly complain of the pernicious activities of politicians, but apparently fail to realize that many rascals are kept in office by the support of the newspapers. If these newspapers were as honest and patriotic as they pretend to be, they would gladly help the railroads to drive the grafters and bums from public life, since all officeholders who oppose the railroads fall within that classification. Show me a politician who persecutes the railroads, and I will show you a dishonest man who is unworthy of the privilege of even living in this country—much less bossing it!

The attitude of the yellow newspapers is as notorious as it is infamous. The unpleasant truth is, however, that journalistic rascality is not confined to such sheets, but extends to supposedly respectable and reliable dailies.

Many of these holier-than-thou newspapers ignore the protests of railroaders and technical men, and persist in their policy of printing silly editorial opinions which are laughed at by every competent man who reads them. They mislead the public, however, and that is a serious matter.

Newspaper editors know as much about practical railroading as a cat knows about calculus, and yet they imagine that they can afford to insult or ignore men who have forgotten more than they will ever know.

Among local papers, the New York *Times* is one of the most flagrant offenders. It does show some friendliness toward the railways in an abstract way. When any practical question comes up, however, it always publishes the opinions of tyros or ignorant meddlers, and refuses to give a fair hearing to experienced men.

I think that it is about time to demand a reform, and believe that your paper can do much to improve conditions. From what I have been able to learn, some of our oldest railroaders and technical men have been treated with haughty contempt by newspapers which should have treated their communications with the respect and consideration to which they are entitled, and which they command in mechanical circles.

ARTHUR CURRAN.

New York, N. Y.

Poorly Paid Machinists.

EDITOR:

Under the heading of "The Outlook for the Railroads," the editorial published by you in last month's issue of RAILWAY AND LOCOMOTIVE ENGINEERING is not only in fine keeping with the spirit of strong common sense always conspicuous in your pages, but as giving voice to the voiceless grievances under which a large and important section of railroad employees live and move and have their bitter being, the article stands alone. Taking the liberty to refer particularly to the machinists, it may safely be said that there is no class of skilled mechanics so poorly paid as those who are occupied in railroad shops. Fifty years ago the trade was a profession. Now it takes the rear rank with street sweepers, considerably behind that of a bricklayer's helpers or third class hotel dishwashers. It would be difficult to explain why this is so other than the reason that you give that there is no general organization of railroad machinists sufficiently strong to command attention.

Today the wages are from 26 to 29 cents per hour, with a little additional in cases where piecework is the rule. In either case, what with scientific management and time schedules, the machinists' noses are at the grindstone all the time. His lean and hungry face betokens alike the marks of incessant toil and the empty platter. As prices go up he goes down. He is at the wrong end of the social plank. He has grown downwards, like the cow's tail, for a generation. Older men declare that forty years ago the wages were 28 and 30 cents an hour. How those unfortunate men with families to provide for manage to exist is one of those mysteries that may be revealed to us hereafter.

Then in addition to the general dispiriting condition of ill-requited toil, there are special visitations of mingled misery that might make the angels weep. If holidays fall on Fridays, or even on Thursdays, as they will do for the next six months, the shop must be closed for the remainder of the week. Some financial genius in the managerial board sees an opportunity to show a reduction in expenses—a dramatic flourish that puts him on the high road to promotion and sends the machinists and others to the pawnshop. These holidays are days to be remembered, especially on pay days. Then when February comes, a short month at the best, that is usually the month when the suffering mechanic gets it in the neck, or pocketbook, rather. He is lucky if he gets in three weeks that month. The birthdays of great men like Washington or Lincoln make him groan. The celebration of the Declaration of Independence is a hollow mockery to him. Another day's idleness puts him further away from independence.

The blacksmiths, boilermakers, carpenters and painters are not quite so badly off, but they are bad enough. If there is any error in my estimate of the condition of the machinists, it would be proper to correct me, and it would be a gleam of joy to know that things are not as bad as they seem to me. At any rate, as a class of mechanics of great skill and ability, the railroad machinist of today is not rewarded as he should be.

W. RICHARDSON.

New Haven, Conn.

Variations in Lead in the Walschaerts Valve Gear.

EDITOR:

Your correspondent, J. B. Souris, Manitoba, Can., in his query, printed in your December number, probably had heard vaguely of the way the valves are being set experimentally on engines with Walschaerts gear on some engines in passenger service on one of the largest roads in this country.

It was believed that heavy passenger engines would show better performances if in starting a train the lead was negative, but with pre-admission being secured as the speed increased. It was suggested that any kind of valve setting would permit an engine being backed out of the roundhouse and on to her train; and that all of a passenger engine's revenue-producing work is done while running with the reverse lever in forward gear. So, on certain engines with inside admission valves set originally with a certain amount of lead (at all points of cut off), the eccentrics were re-set at a farther distance from the crank-pin, at enough greater

angle than the theoretical 90 degrees that with reverse lever in forward corner notch the valves were line-and-line. Now, as the reverse lever is hooked up, lead, or pre-admission, develops, increasing as the point of cut-off is shortened, until with the reverse lever in center notch of quadrant the valves have the original amount of steam lead for both ends of the cylinder. But, as the reverse lever is moved from center into back gear, the lead increases until in the back corner notch the lead is twice the amount that the valves had before the position of the eccentrics was changed.

Now, if the proportions of the combination lever are such as to set the valves normally line-and-line with the admission ports, and (with inside admission) we change the eccentric to a position nearer the crank-pin it will provide lead; and suppose we make it 1/8 in. in full gear; then, as the lever is hooked up the lead decreases until the valves are line-and-line with the reverse lever in center notch, the lead beginning to appear again as the lever is moved into back gear, and in the back corner notch the valves will be 1/8 in. blind. This would give results such as your correspondent alludes to, although only beneficial to an engine that did practically all of its work while backing.

W. W. Wood,
Air Brake Instructor.

C. I. & L. Ry.,
La Fayette, Ind.

First Compound Locomotives in America.

Editor:

On page 430 of December issue of the Railway and Locomotive Engineering, it is stated that the first compound locomotive operated in the United States was in 1875, on the Worcester & Shrewsbury Railroad. The locomotive referred to commenced running in July, 1873, and continued to do so for several years.

In 1867 the Erie Railroad had one of their simple engines changed to a Tandem compound, having high pressure cylinders of 12-inch diameter and the low pressure 24-inch, according to the patent of J. L. Lay, dated October 29, 1867. Number of patent, 115,672. This engine remained a compound for quite a long time, but was finally changed to a simple engine. The writer had the pleasure of riding on this engine when being operated as a compound.

C. Ritic.

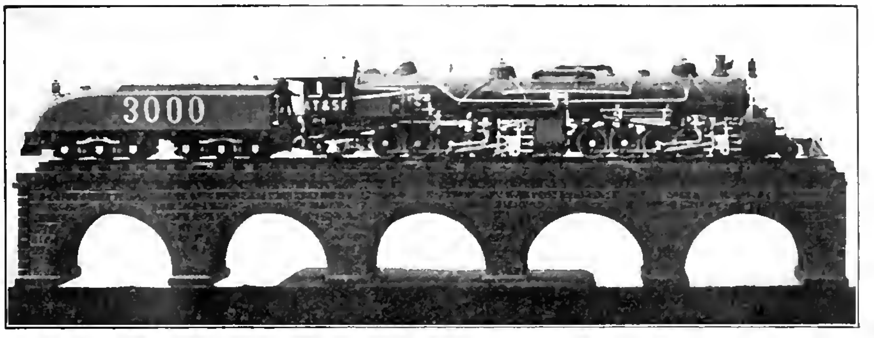
A Mallet Model.

Editor:

The enclosed is a photograph of a model of the largest locomotive in the world, one of the 2-10-10-2 type of the Santa Fe railroad. It is made of bone and wood and all carved by hand, and is in perfect running order. The model is 62½ inches in length. The driving wheels are lifted a little above the rail, and the engine is run by an electric motor, a power belt passing up through the second pier. The wheels are of black walnut with rims of hickory. The axles are mounted with pearl. I began the job last New Year's Day and finished it on May 10. There is no machine work of any kind on the model. The materials are black walnut, hickory, cherry, rosewood, mahogany, ebony, bone, and pearl.

Ernest Warther.

Canal Dover, Ohio.

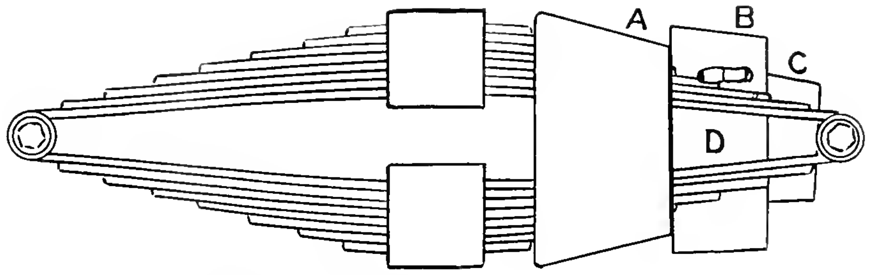


MODEL OF A SANTA FE MALLET LOCOMOTIVE.

Mounting Springs on Engine, Tender and Car Trucks.

By J. G. Koppel, Montreal.

Enclosed is a drawing of a mechanical appliance which has made possible the mounting of truck springs without any trouble. This useful device should replace the present arduous method of using a driving block and sledge hammer. The appliance is self-explanatory. A, is a special made square iron ring made sufficiently large to receive the spring in a minimum closing position. B, is a piece of plate iron with a hole in one end adapted to receive a split pin, and C, is a wooden wedge. The method of operating the appliance is as follows: The spring to be mounted in a truck is first put on a hydraulic or screw press and pressed to the closed position. Then the ring A is put on the spring as far as it will go. Then the piece B is put in between the two springs, generally the springs are made two or four together. The wedge-shaped piece C, as per drawing is put in. When a single spring is used only when ring A is put on then instead of pieces B & C a solid piece of wood may be put in between the two half springs at D, to prevent the ring B from coming down. Then the spring is ready to put in place. Latterly with a hard hammer drive out the wedge and the ring will come down easily, and the spring will rest in its desired position.



DEVICE FOR MOUNTING TRUCK SPRINGS.

The Fireproofing of Timber to Be Used in the Construction of Railway Passenger Coaches.

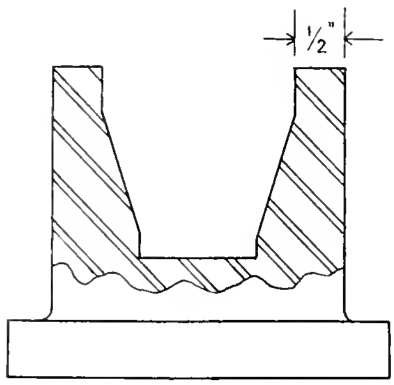
By T. Osborne, Manchester, England.

Recent railway accidents accompanied by a deplorable loss of life in both England and France has rivetted public attention abroad to the necessity of constructing railway carriages, as far as possible, of uninflammable materials. The desirability of eliminating all non-fireproof material is of course by no means a new one. At least one large English railway company is now experimenting with the construction of passenger coaches of the all metal variety. Another company claims to have fireproofed all its rolling stock, without the elimination of woodwork, which has such important structural and decorative advantage. It will be readily conceded that fireproof materials should be used for all purposes involving both human transit and habitation, both on land and water, as well as stationary and in motion. The traveling public feels an indefinable sense of added security, if provided with accommodation known to have been fireproofed. The system of fireproofing timber used in the construction of railway carriages, now in use in England, may be briefly described as follows: It has been in operation both for railway and other purposes for several years, and

has successfully stood the tests of repeated and severe trials. The experimental stages are over and it is now recognized by experts as thoroughly established and reliable.

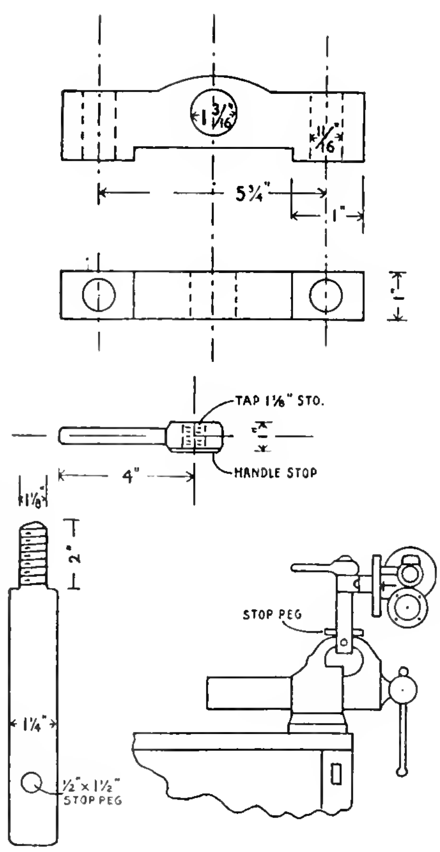
The process of fireproofing consists of the impregnation of the pores and fibres of the wood with chemicals, such as render the timber absolutely flame-proof. The process, which is carried on in large, well organized works, with plant capable of dealing with a very large quantity of timber annually, is commercially remunerative, and similar works erected in any large center of population should be equally successful, whether the output is limited to railway work, or is used for other purposes as well. It is important for railway managers to realize that the timber, which has been subjected to the process loses none of its natural characteristics and has no injurious effect upon metal work, such as fittings, varnishes, glues, nails and so on which may be brought into contact with it. During the preliminary stages through which the process went, many difficulties had to be overcome. The first necessity was to find an "antepyrine," or fireproofing solution, which would satisfy certain indispensable conditions laid down by railway and other experts. The most important were that it should have no harmful effect upon the timber itself, nor upon any materials, which would come into contact with it, when it should be structurally applied. It was further necessary to place on record for the guidance of the works managers reliable data and principles controlling the precise conditions subject to which every variety of timber could be successfully treated. It soon became evident that the details of the process would have to be varied to suit every class of timber. Some varieties of wood are quite unable to withstand the pressure necessary for others. At first there was considerable doubt as to the duration and degree of each step of the process, when applied to a fresh consignment of timber. Now the managers work with unfailing certainty and know precisely how to treat any quality or variety of timber, which may be forwarded for fireproofing.

In principle the fireproofing process consists of substituting a chemical solution capable of coating each pore and fibre of the timber to be treated with a non-inflammable salt, to replace the moisture or sap contained within the pores under natural conditions. At the works now in operation the pores of the timber are at first opened by steaming, the natural moisture is then extracted by the creation of a partial vacuum, and the fireproofing solution is then applied under pressure. Finally the timber is dried in such a manner as to remove the moisture without any volatization of the fireproofing chemical and without any injury to the character of the timber itself. Railway engineers, carriage builders and others would be interested to watch the several stages of the fireproofing process, as now carried on at the extensive works in England, which have for several years turned



DIE FOR FITTING CONE PACKING.

out many 100,000 cubic feet of flameproof timber. The timber to be treated is piled on to small trucks, fitted with iron hoop tops, which serve the double purpose of keeping the wood in position and as gauges to regulate the quantity for each



HOLDING DEVICE FOR H 6 DISTRIBUTING VALVE.

load. The trucks are run into large iron cylinders, fitted with air-tight doors; as soon as each cylinder has been filled, it is hermetically closed and steam is sent in to emerse the wood and open the pores. The managers know precisely the length of time required by every variety of timber to complete this preliminary process; exhausting pumps are then put into operation, and as the pressure is reduced the timber parts with its natural moisture. As soon as that has taken place the fireproofing solution is forced into the cylinders, and pressure applied sufficient to force the solution into the innermost pores of all the timber. Again the managers know the precise pressure and the length of time required for all varieties of timber. The last step is to remove the trucks from the cylinders and to convey them to specially equipped sheds, in which the timber is dried by currents of hot air.

For a large plant capable of dealing with 400,000 or 500,000 cubic feet of timber annually, three cylinders are necessary, 70 to 80 feet in length, and two shorter ones 40 to 45 feet long, all available for timber of average texture. For hard, dense classes of wood one or two cylinders of smaller dimensions are necessary, of greater structural strength. A spare cylinder is desirable of medium size for experimental work and as a substitute in case of stoppage for repairs, or to help over a rush of work. Fireproofed wood does not differ in any way as regards outward appearance from timber in its natural state. When it is brought into contact with flame it will not ignite, however persistently the flame may be applied. Charring is all that takes place. The only difference between the natural and fireproofed wood that can be detected during working the wood for constructional use, is the necessity for a more frequent sharpening of high speed tools, when they are employed.

Die for Fitting Cone Packing, and Holding Device for H 6 Distributing Valve.

By F. W. Bentley, Milwaukee, Wis.

The application of cone packing to air pump piston rods is in a great many cases done in such a manner that considerable trouble is experienced and the packing often unjustly condemned. The greater part of the trouble of course lies in the necessity of sawing the cone into halves and the resultant elliptical shape of the cone after cutting, which unless fitted carefully to the gland is the source of a more or less aggravating blow.

The attached sketch is in general descriptive and explanatory of a steel die into which the packing is dropped after sawing and swedged to the exact shape and size of the gland with the use of a hammer and a light soft copper ram. This is done in a few seconds and assures a better outside fit of the two segments in the gland than could be obtained by the use of a file. Of course the degree of taper is necessarily different in many instances to suit the taper of the cones used as standard. The use of as narrow a

hack saw blade as possible is recommended to retain as much of the body of the cone for boring to the size of the piston rod.

LOCOMOTIVE READY TO BE HAULED TO MAIN LINE.

The writer has used one of the above dies for me time and has met with gratifyir results in obtaining a perfect repack rod as well as being able to pa l with a degree of rapidity which is often imperative on hurried roundhouse repairs.

The other device refers to the H-6 distributing valve which is a part whose shape makes it an unwieldly part to hold in any kind of a vise while grinding in the various valves and fitting the packing rings of the pistons. The work necessarily calls for a change of the position of the valve in the vise a number of times, and at that the height of the ordinary vise is such that a stooping position is continually required during all work on the valve in the vise.

The above sketch gives the simple details of a jig for use in holding the valve in any position in the vise necessary to locate it for careful repair work. The upper portion enables the valve to be swung around and tightened for convenience with respect to light and access to the parts. The pin through the leg of the jig makes it possible to swing the valve for convenience also in examining the valve or applying the parts.

The jig is simple in construction and decidedly worth its slight expense in connection with the over-hauling of the sensitive distributing valve and it also has the advantage of making it possible to grind a perfect joint in a very short space of time, which is quite an advantage, especially in roundhouse work.

Railroading in the Vermont Hills.

By George H. Selina, Rochester, Vt.

Enclosed are views of the railroad being constructed for the Eastern Talc Company to convey talc rock from the company's mines in Jerusalem to the mills on the White River Railroad in Rochester. This road, now nearly com-

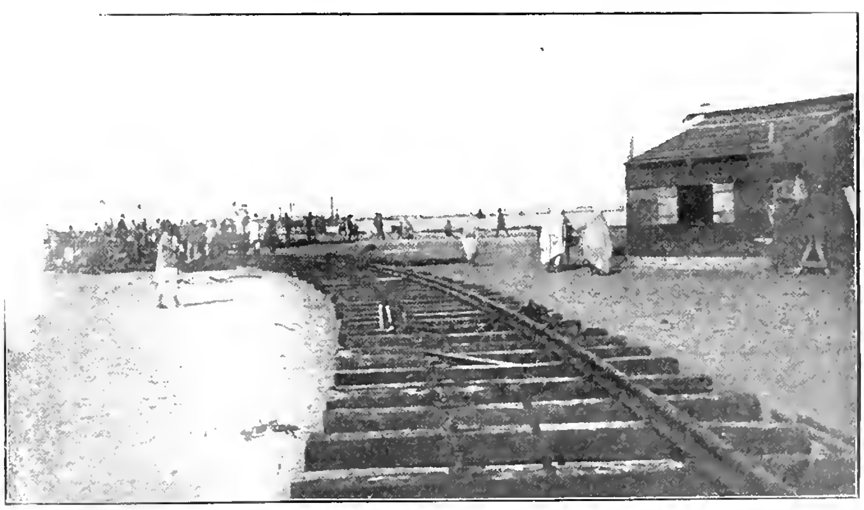
LOCOMOTIVE ON THE WAY UP THE INCLINE.

pleted, will be about five miles in length, with five switchbacks and a maximum grade from 5 to 7 per cent., and curves almost too short to calculate. The locomotive shown is an H. K. Porter build. The weight is 24 tons, with cylinders 12 ins. x 16 ins. The driving wheels are 33 ins. in diameter. The steam pressure is 170 pounds. The cars are steel dump cars carrying seven tons of rock, and equipped with hand brakes. The locomotive is equipped with the Westinghouse G 6, also water brake. The track is of the 3-feet gauge type. On the incline where the locomotive is being hauled to the main line the mine cars are being loaded on incline car and are conveyed to the mill by gravity, running down the track themselves, and the locomotive hauls the empty cars back up the hill again.

Building Railways in Tripoli.

By L. Lorman.

There are many interesting aspects in railroad construction in that part of Africa recently acquired by the Italian government. Before the Italians occupied Tripoli there was only about nine miles of a narrow gauge track in that country running from the sea coast to some stone quarries and bringing material for dock building. In a few months the invaders were working on the construction of



BUILDING RAILWAYS IN TRIPOLI.

four lines and there are now several hundred miles of track finished and in constant operation. The gauge is 95 centimeters—about 38 inches—the common gauge of the Italian secondary lines. The sand dunes of Tripoli are far reaching and are constantly shifting with the vagaries of wind and weather. The problem of track building was no easy one, as in a sand storm the track would be

completely covered in a couple of hours The French had already overcome the difficulty in Algiers by experimenting with plant life in the sand hills where it could be induced to take root and grow aided by a part covering of alluvial soil. The Italian engineers covered part of the dunes with boughs of trees and stake hedges and barriers of brushwood, and already in some parts shoots of tamarisks, pines and wild roses are in profusion, and thus the railroads are not only being protected but the desert is being garlanded with flowers.

Fortunately just below the sand dunes with their shifting surfaces, the ground is firm and fit to sustain the track without ballasting, as the rolling stock is not heavy. The locomotives are of the small eight coupled type and somewhat resemble the early engines of the New York Elevated railroad, with outside cylinders, and Walschaerts valve gear, and Hardy automatic brake. Strange as it may appear, it is difficult to secure native labor of any value. The Arabs themselves, and even the camels, cannot be induced to perform a reasonable day's work. Italian workmen and Spanish mules are the best available material for construction work so far. The accompanying illustration shows a portion of the railroad track laid on the level sands near the sea shore at the city of Tripoli.

First Steamer to Cross the Atlantic.

At a meeting of the British Association in 1836, in a lecture on steam navigation, Dr. Lardner, then considered the most eminent engineering authority in the world, said: "As to the project of establishing steam intercourse with the United States, which has been announced in the newspapers, of making the voyage direct from New York to Liverpool, it was, he had no hesitation in saying, perfectly chimerical, and they might as well talk of making a voyage from New York or Liverpool to the moon."

Contrast the above with the following which appeared, only two years later in the New York *Herald* of 25th April, 1838: "Nothing is talked of in New York but about the *Sirius*. She is the first steam vessel that has arrived here from England, and a glorious boat she is. Every merchant in New York went on board her yesterday. Her commander, Lieutenant Roberts, R. N., is the first man that ever navigated a steamship from Europe to America."

Thus was the confident announcement made before the British Association speedily falsified by accomplished fact. Indeed, the very speech in which it was made was the immediate cause of sending the *Sirius*, the pioneer of Transatlantic steam traffic, on her initial and epoch-making voyage to New York. It came about in this way.

Mr. James Beale, of Cork, who was largely concerned in steamship business, during a visit to London, was discussing with some friends Dr. Lardner's speech, quoted above, and expressed his opinion on the subject by saying that if anyone would join him, he would guarantee to coal and send out from Cork to New York a steamer, which was already in existence, and find a captain who should be competent to navigate her. His project was agreed to, and he chartered the *Sirius* from her owners, the St. George Steam Packet Company, of Dublin, and Lieutenant Roberts, R. N., of Ardmore, was appointed as her captain.

The *Sirius* was built for the St. George Steam Packet Company by Messrs. Menzies & Son, of Leith, her machinery being supplied by Messrs. J. Wingate, of Glasgow. She had two masts and one funnel, with a figurehead of a dog holding between its foreparts a star representing the dog star Sirius, after which she was named. She was of 5,500 tons burthen, her length 178 4-10 feet, breadth amidships 25 8-10 feet; and her cost was £27-000.

Having embarked her passengers, in number forty, says Captain Roberts, the *Sirius* started from Cork on 3rd April, 1838, at 10:30 a. m., in company with the *Ocean*, another splendid steamer of the St. George Steam Packet Company. On leaving Passage, about seven miles below Cork, we were loudly cheered by the inhabitants, together with the most respectable families in Cork, who had assembled, with warm hearts and handsome faces (the ladies, I mean) to witness our departure and wish us success in our passage to our Transatlantic brethren. Most of the gentlemen interested in our vessel proceeded with us as far as the Cove of Cork, where we stopped to let the *Ocean* come alongside to take the above gentlemen out, which having been done, with three hearty cheers, and many heartfelt wishes, we gallantly bent our way for New York.

It is interesting to note the following facts: The saloon fare was 35 guineas (the same as the sailing ships); second cabin, 20 guineas; and steerage, 8 guineas. The average speed yas 161 knots per day; highest 220, lowest 85. The total amount of coal consumed for the voyage of 2,897 knots was 450 tons, and the engines made 15 revolutions per minute.

On 22nd April, after nineteen days' passage, the *Sirius* sighted land, and at 10 that night anchored off the Battery, New York. On the 23rd the Mayor and Aldermen and many inhabitants of the city, together with several army and navy officers, came on board to congratulate Captain Roberts on his safe arrival. Alderman Hozie, during the reception in the cabin, welcomed to the great city of the New World the gallant adventurers from the Old. He looked upon this, he said, as a great event, and in the name of the city he awarded to the gallant captain and the gallant crew of the *Sirius* "the high honor of creating a new era. If it did not bear his (the captain's) name over the world with the imperishable lustre of the great discoverer of America, it gave him a name among the great benefactors of mankind." The alderman then proposed the health of Captain Roberts, and the toast was drunk standing, and received with deafening cheers.

The *Sirius* left New York on her homeward voyage on 1st May, and at her departure thousands of people assembled on the wharf to wish her a prosperous passage; the Battery saluting her with seventeen guns, a mark of respect seldom or never before shown to any merchant vessel. She arrived at Falmouth on 18th May, after a boisterous passage, and left the same day for London, where she duly arrived all well. So ended the initial voyage, outward and homeward, of the first steam vessel which crossed the Atlantic.

Reporting Train Accidents.

The principal railroad managers in the country have introduced the practice of making full reports of all railroad accidents resulting in the injury or death of trainmen or passengers. This is a very desirable reform, for the old practice was to suppress all information concerning accidents, a senseless practice which was very cruel towards a great many persons. It would be difficult to portray the terrible fear that the wives, mothers and children of trainmen had to endure when news of a train accident reached them and all particulars were withheld.

Although the officials did their best to suppress all the facts about accidents, reports of wrecks spread like wild fire in every railroad community and threw all the families interested into an agony of suspense and fear. The secrecy maintained was not necessary and did no good. We trust that the new practice of sending out full information concerning accidents may become general and that the silly secrecy of the past may never be revived.

Steam Turbines.

At the first regular meeting for the season, on December 19, 1913, Mr. J. A. MacMurchy, of the Westinghouse Machine Co., Pittsburgh, Pa., addressed the Toronto section of the American Institute of Electrical Engineers, on "Steam Turbines." The address was illustrated, and created much interest. The discussion that followed was of the most interesting kind and the large audience showed their hearty interest in the proceedings.

4-8-2 Type of Locomotive for the Missouri Pacific

Seven mountain type, passenger locomotives have recently been delivered to the Missouri Pacific Railway Company by the American Locomotive Company.

These locomotives were designed to eliminate the double-heading of the regular passenger trains on the Missouri division, between St. Louis and Poplar Bluff, a distance of 165 miles. Leaving St. Louis, the first 42 miles is composed of practically a continuous ascending grade having a ruling of 0.4 per cent. The next 85 miles includes the crossing of the Ozark Mountains, which is composed of the ascending and descending of five summits. This is the crucial part of the entire division and is made up of the following very heavy grades: The first summit has a grade of 1.05 per cent., 4 miles long; the second summit, 1.03 per cent., 10 miles long; the third summit, 0.9 per cent., 14 miles long; the fourth summit, 1.9 per cent., 5 miles long with 5 degs. uncompensated curves; the fifth summit, 1.5 per cent., 5 miles long. The remainder of the division is composed of a long descending grade.

Passenger traffic on this division is very heavy. Up to the present time a Pacific type locomotive, having a total weight of 259,000 lbs., weight on driving wheels of 165,000 lbs., and a maximum tractive power of 36,800 lbs., has been used in this service. Two of these Pacific type locomotives were necessary to handle a train of nine cars or more.

The mountain type locomotives have enabled the railway company to handle trains of 12 to 14 cars, or a tonnage up to 820, over the 1.9 per cent. grade at a speed of 18 miles per hour; one locomotive performing this service, whereas formerly it required two of the Pacific type.

This is another striking example of the savings obtainable by designing locomotives exactly fitted for their work and confining them to their particular territory with a view of getting the maximum efficiency from every portion of the property.

Compared with the Pacific type, the mountain type has a total weight, engine and tender, of 457,500 lbs., as against 420,500 lbs. The mountain type has a tractive effort of 50,400 lbs., as against 36,000 lbs. for the Pacific. With only 8.8 per cent. increase in weight an increase of 37.0 per cent. in maximum tractive power is obtained.

• A weight limit of 210,000 pounds on drivers was specified. This necessitated a very carefully designed boiler. In the following table a comparison is made of the boilers of the mountain and Pacific types.

	Pacific type.	Mountain type.
Pressure	180	170
Boiler—		
Type	Ex. Wag.	Con. Conn.
I. D., first ring	72⅜ in.	74¼ in.
O. D., largest course	83⅜ in.	87½ in.
Firebox—		
Length	108⅛ in.	108⅛ in.
Width	66 in.	75¼ in.
Tubes, number and diameter	223—2 in.	218—2 in.
Flues, number and diameter	32—5⅜ in.	32—5⅜ in.
Length of flues	20 ft.	20 ft.
Combustion chamber, length	......	37½ in.
Heating surface—		
Tubes and flues, sq. ft.	3,221	3,165
Firebox, sq. ft.	209	260
Arch tubes, sq. ft.	26	26
Total, sq. ft.	3,456	3,451
Superheating surface, sq. ft.	757	761
Grate area, sq. ft.	49.5	56.5

It will be noted that while there is practically no difference in the total heating surface of both boilers, the mountain type boiler contains a combustion chamber. By increasing the front end diameter 1⅞ ins., and the diameter of the largest course 3⅞ ins., the addition of the combustion chamber made a reduction of only 56 sq. ft. in tube heating surface, but added 51 sq. ft. to the firebox heating surface.

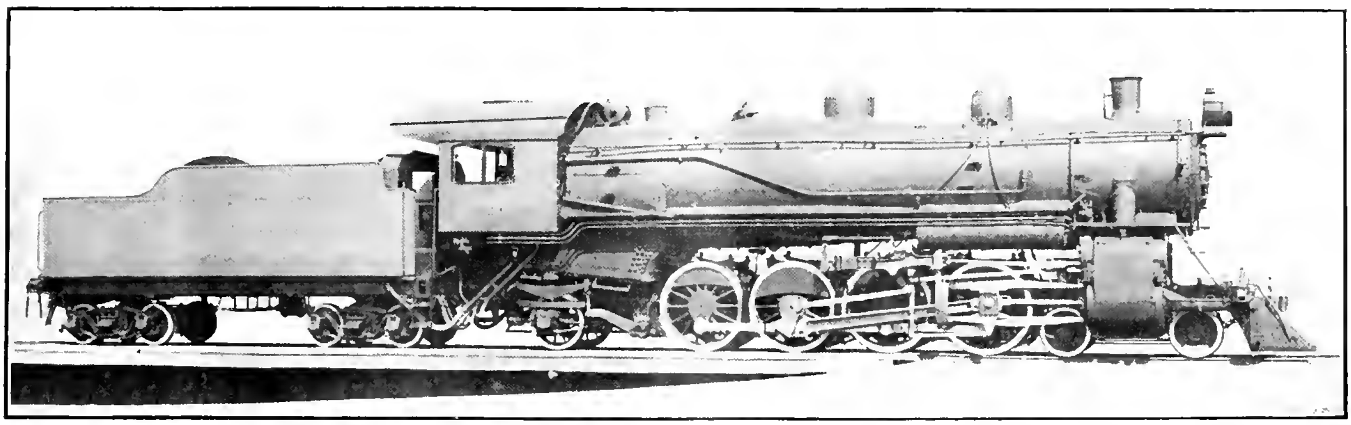
Firebox heating surface has approximately six times more evaporating value than tube heating surface. Considering the 10 lbs. reduction in pressure, the addition in grate area of 7 ft. coupled with the greater value of the heating surface it will be observed that the capacity of the boiler has been greatly increased.

This boiler, being restricted by the weight limit, would not allow the application of cylinders larger than 28 x 28 ins. To obtain the desired tractive effort, the driving wheel diameter was reduced to 63 ins. As these mountain type locomotives are not intended for the sustained high speeds demanded of the Pacific type, this 63 in. wheel coupled with the above mentioned boiler allows these heavy trains to ascend the steep grades at comparatively high speeds. It is also amply large to attain the necessary speed when descending the grades where boiler capacity does not become a factor.

In every detail, as in general construction, the design embodies the latest approved practice. It is equipped with a superheater, firebrick arch, screw reverse gear, outside steam pipes, extended piston rods, the builder's latest improved outside bearing trailing truck, the builder's latest design of throttle lever, and the Foulder design back end main rod.

This main rod deserves special mention. With this solid end main rod, four of the 1⅜ in. bolts of the strap end main rod have been eliminated, and an actual saving in weight of 115 lbs. per rod was obtained. Thus a saving of 115 lbs. counterbalance was secured. Also only one pattern is required for the bearings, as the same brass is used front and back of pin, the taper being on the two adjustable wedges. The heavy wedge immediately in front of the bearing extending to the full depth of the rod opening, and being of greater depth than the bearing itself, provides a fine support for the brass and prevents it from cocking and becoming distorted. Other features of this solid end are its simplicity and the time saved in taking it off the engine; and there are no bolts to renew or holes to ream.

These locomotives are not merely big,



4-8-2 TYPE LOCOMOTIVE FOR THE MISSOURI PACIFIC RAILWAY COMPANY.

R. J. Turnbull, Mech. Supt. American Locomotive Company, Builders.

but were designed with careful consideration of all the conditions of service, which the American Locomotive Company's engineers had first thoroughly studied. They are the product of this company's wide experience in the design and construction of big locomotives, supplemented by the complete knowledge of the officials of the railway company's Motive Power Department.

The following dimensions might be interesting:

Track gauge—4 ft. 8½ ins.

Fuel—Bituminous coal.

Cylinder—Type piston, diameter, 28 ins.; stroke, 28 ins.

Tractive power—50,400 lbs.

Factor of adhesion—4.13.

Wheel base—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total, 36 ft. 5 ins.

Heating surface—Tubes and flues, 3165.2 sq. ft.; firebox, 260 sq. ft.; arch tubes, 25.5 sq. ft.; total, 3450.7 sq. ft.

Superheating surface—761 sq. ft.

Grate area—56.5 sq. ft.

Wheels—Driving diameter outside tire, 63 ins.; center diameter, 56 ins.; engine truck, diameter, 33 ins.; trailing truck, diameter, 42 ins.; tender truck, diameter, 33 ins.

Axles—Driving journals main, 11 x 12 ins.; other, 10 x 12 ins.; engine truck journals, 6 x 12 ins.; trailing truck journals, 8 x 14 ins.; tender truck journals, 6 x 11 ins.

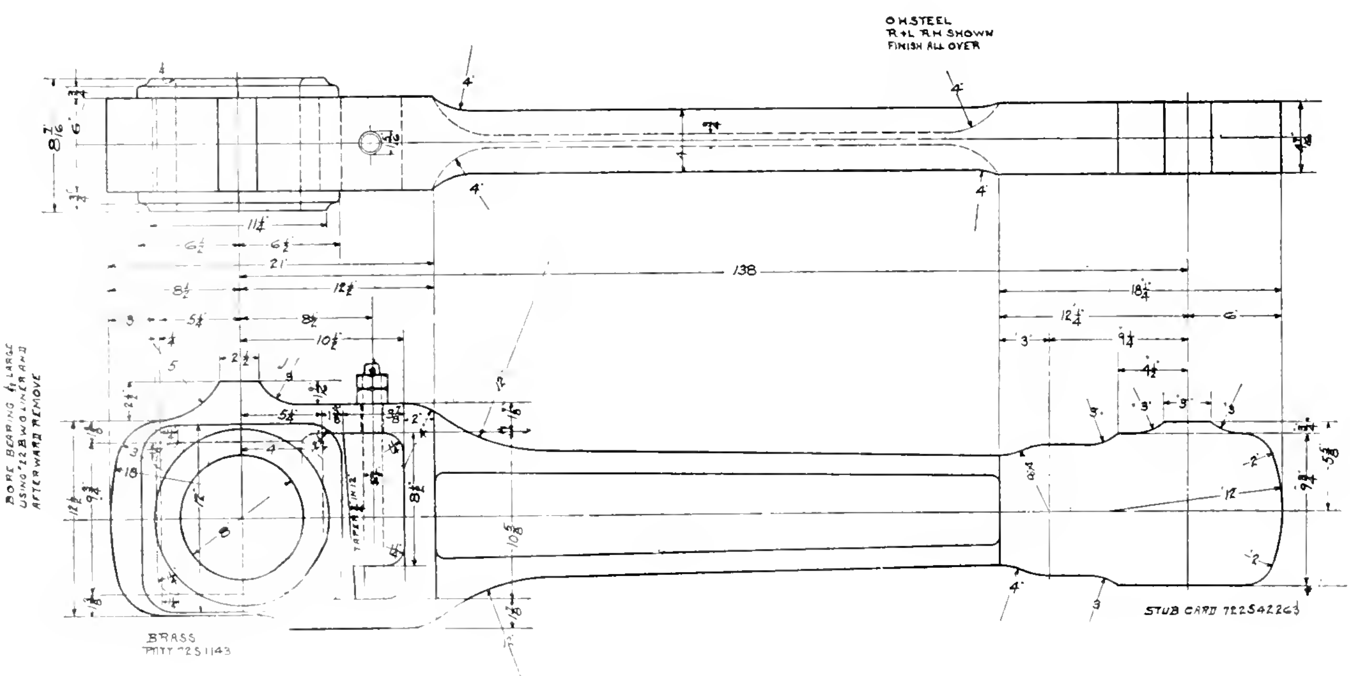
Tank—Capacity, 8,000 gals.; fuel, 14 tons.

Valves—Type, 14 ins.; piston travel, 6½ ins.; steam lap, 1 in.

Setting—3-16 ins. lead.

Safety Medals.

The E. H. Harriman medal for having done more than any other company for the safety of its employees was awarded to the Southern Pacific Railroad at a meeting of the members of the American Museum of Safety, which was held in the Waldorf-Astoria, New York, last month. It appears from the reports that not a life had been lost on the railroad for five years. *The Scientific American* medal was awarded to the Welin Marine Equipment Company; the Travelers' Insurance medal to the New York Telephone Company for work done for the safety of the women employees; the St. Louis Livingston Seaman medal to the United States Steel Corporation, and the Rathenau medal to the General Electric Company.



VIEW OF DETAILS OF SOLID END MAIN RODS.

Wheel base—Total, engine and tender, 70 ft. 0 ins.

Weight in working order—296,000 lbs.; on drivers, 208,000 lbs.; on trailers, 40,000 lbs.; on engine truck, 48,000 lbs.; engine and tender, 457,500 lbs.

Boiler—Type, conical connection; O. D. first ring, 75¾ ins.; working pressure, 170 lbs.

Firebox—Type, wide; length, 108⅛ ins.; width, 75¼ ins.; thickness of crown, ⅜ ins.; tube, ⅝ ins.; sides, ⅜ ins.; back, ⅜ ins.; water space, front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

Crown staying—Radial.

Tubes—Number, 218; diameter 2 ins.

Flues—32; diameter, 5⅜ ins.

Thickness—Tubes, No. 11 B. W. G.; flues, No. 9 B. W. G.

Tube—Length, 20 ft. 0 ins.; spacing, ⅞ ins.

Countersunk Rivets in Boilers.

Mr. H. I. Wilkinson, a practical boilermaker states: I have worked in locomotive repair shops several years, and where the rivets are inside the firebox of locomotive boilers the use of countersunk rivets is quite extensive; in fact, on some, if not all, railroads the rivets inside the firebox are countersunk altogether, more especially along the side sheets and flue sheets. The mud-ring rivets are below the fire and they are not always countersunk, but quite frequently are. It seems that the intense heat inside the firebox of this class of boiler burns off the heads if they are not countersunk nearly flush with the sheet. In putting in a heavy flue sheet in the firebox the edge of the flange is generally scraped down quite a bit for the same reason, for if it is left very thick the heat injures it and makes it crack and leak all the more quickly.

The Trans-Continental Railway.

The main line of the Transcontinental will total a trackage of 3,550 miles from Moncton to Prince Rupert; but that does not comprise the whole system by any means. There are to be many branch lines taking care of settlements in sections of the country hitherto unprovided with transportation facilities. These lines, upon which, in some instances, a beginning has been made, will amount to over 1,000 miles of added trackage, and will tap large territories hitherto inaccessible. These branches, or lateral lines, are to serve new populations, which will follow them in line of the system, and then spread over the new country served by spur trackage, which will connect them with the great artery through which their products will be brought to the centres of population in older Canada.

Questions Answered

Pounding on Piston-Valve Engines.

E. R. M., Waycross, Ga., writes:—Please explain why a piston-valve engine will pound when running when the steam is shut off and the reverse hooked up near the center, and will cease pounding when the reverse lever is dropped into the corner notch. A.—The pounding which takes place in piston-valve engines while running with steam shut off and with reverse lever hooked up, is due to compression in the cylinders and the inability of valves of this type to relieve themselves. As the piston moves backward and forward in the cylinder, air is drawn into the cylinder through the vacuum valve, or what is generally known as the steam-chest relief valve. When the exhaust port closes as the piston is on its return stroke, the air, which was previously drawn into the cylinder, is confined between the valve, cylinder head and piston, and consequently must be compressed as the piston completes its travel. This compression, when the lever is hooked up, becomes sufficient to throw extra strains on the crank pin and takes up the lost motion, causing pounding. The nearer the reverse lever is to the corner notch, the nearer will the piston be to the end of its travel before the exhaust opening closes, and when the lever is in the corner notch the exhaust closes so late that there is not enough air left in the cylinder to cause any effect to be noticeable in the way of pounding.

It may be added that slide valves are subject to the same conditions, and the same action takes place, but as the compression begins to rise in the cylinder the valve is lifted from its seat and the compresesd air escapes into the steam chest, and consequently does not produce pounding. A piston valve cannot lift from its seat, and hence pounding is the result.

Running with Connecting Rods on One Side

W. C. W., Minneapolis, Minn., writes:—I submit the following for your opinion. I am running a ten-wheel link motion engine, and a few days ago, when about 60 miles from the terminal, discovered fractures that made it necessary to take down all the rods on the right side. After blocking cross-head proceeded with all rods up on the left side, and being a local passenger run was obliged to make all stops as usual and arrived safely at the terminal and placed the engine in the roundhouse with everything in perfect condition excepting the original fractures referred to. The mechanical officials disapproved of bringing the engine in under the conditions described, and claimed that the rods might have "buckled," and other serious damage might have followed, and accounted for safe arrival through good luck. I fail to see where the rods could possibly have been damaged or crank pins broken. To my thinking buckling could only occur on centers with pins being forced out of alignment, and this could only be brought about by main rod being in operation on the opposite side.

Locomotive builders make the rods strong enough to stand all the strain that will be put on them by one cylinder, and a margin for safety. My experience has been that where a rod on one side broke and before the engine could be shut off the combined power of both pistons broke the rod on the opposite side; this has happened on different occasions in my experience. A mere statement that this or that method is correct does not satisfy me. If wrong, would like to have it pointed out exactly where the danger lies. What is your opinion? A.—We differ from you in regard to the safety of any kind of locomotive running under the conditions described. The principal reason is that when one main rod is removed the other main rod can have no influence at all upon the wheels to which the disconnected main rod was attached when the cranks are passing the dead centers. When stopping at or near these points, an enormous strain may be put upon the rod when starting again, more particularly if the main drivers should slip. Such a stress would be apt to break the rod. It can be readily imagined that in the event of any lost motion having accumulated in the rods, the main driving wheel may have reached, or even passed, the quarter, while that of the loose trailing wheel may not have reached the center, when a forward movement of the main driving axle might tend to move the rear wheel backwards, in which case a buckling or breaking of the rod or crank pin would be inevitable. This is especially apt to happen at curving or from any cause where slipping may occur. It should also be remembered that when any of the rods are disconnected on one side the counterbalancing of the wheels are much affected, as the counterweights are intended to make up for the weight of the rods and crankpins. Hence the hammer blow, so-called, of the wheels on the disconnected side would naturally tend to give an irregular motion to the wheels, which, occurring coincidentally with the irregular thrusts on the working side, increases to a considerable extent the tendency to bending or breaking of the trailing rods. For these reasons the usually accepted practice is that if it is deemed absolutely necessary to remove the side rods from one side of the engine they should also be removed from the other.

It would be interesting to hear from any of our correspondents in regard to this question. In the development of the locomotive many practices have changed and, doubtless, will continue to change.

Tractive Power of a Locomotive.

A. B. R., St. Thomas, Ont., writes: I would like to have given in the Question and Answer Department a formula for calculating the tractive power of a locomotive in pounds. A.—The common formula for calculating the tractive or pulling power of a locomotive is as follows:

$$\frac{d^2 \times S \times P}{D} = T,$$

in which d represents the diameter of one cylinder in inches, S the length of stroke in inches, P the mean effective pressure in pounds per square inch, D the diameter of the driving wheels in inches and T the tractive power. All of the factors given in the formula are known, excepting P; this is usually taken at 85 per cent. of the boiler pressure when calculating the maximum tractive effort, and at speeds ranging from one to ten miles per hour.

Example: What tractive power will a locomotive develop having the following dimensions:

Diameter of cylinders.......	20 inches.
Length of stroke............	28 inches.
Boiler pressure	200 pounds.
Diameter of driving wheels..	69 inches.

$20 \times 20 = 400 \times 28 = 11{,}200 \times 170 = 1{,}904{,}000 \div 69 = 27{,}594$ pounds.

In general practice it is usual to deduct 10 per cent. on account of friction, but this is a rough estimate based on conditions.

New York Valves and Pumps.

R. W., Cherry Valley, N. Y., asks.—(1) What is the difference between the B-6 feed valve and the old style slide valve feed valve? (2) Can you give me some information on the B-2 and B-3 brake valves? (3) Where can I get some information on the New York air pumps? A.—The B-6 feed valve has a larger regulating valve, a heavier supply valve piston spring, and a hand wheel adjustment. While the entrance of air pressure is slightly different and passes through the slide valve to the brake pipe instead of past the end of it, the operation is identical with that of the older B-3 valve. (2) The B-2 and B-3 equipments are practically obsolete, having been superseded by the L. T. brake equipment. However, if application is made to the New York Air Brake Company, 165 Broadway, New York, N. Y., the company will, no doubt, supply the desired information. (3) The New York Air Brake Company, already referred to, will mail a pamphlet to any address describing their air pumps.

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Ambition of Interstate Commerce Commission.

People familiar with the actions of the Interstate Commerce Commission have had no reason to consider that the individuals of the commission were pining for want of sufficient power to domineer over property owners that vicious laws have placed in the commission's grasp; but that seems to have been the case. In its annual report, made public on December 19, the Interstate Commerce Commission proposes putting Federal control over the railroads of the country of a much more embarrassing character than it has ever been up to the present time. Should Congress grant the power now asked for by the commission, that body will be able to manage the railroads of the country without being responsible for their financial condition.

The commission urges upon Congress the providing of legislation that will authorize the Interstate Commission to have complete jurisdiction over the operating of the railroads of the country. Should this power be granted, the commission will have unquestioned control over everything relating to the movement of trains, over maintaining the condition of roadbed, track and rolling stock, and, in fact, as much authority as if the railroads were national property. That additional jurisdiction added to what the Interstate Commerce Commission already possesses would deprive the real owners of all direction or management of their property. The Interstate Commerce Commission is, no doubt, composed of very smart gentlemen; but their ambition to become railroad operating managers needs to be curbed.

Progressive Achievements of Our Railroads.

All the people connected with train service know that the capacity and power of locomotives have been steadily increasing during the last decade, but few are familiar with the exact particulars. In a Bulletin showing how railroad have obtained their economies we read:

The railroads of the Eastern District participating in the application for a 5 per cent. increase in freight rates have filed with the Interstate Commerce Commission a series of statistical tables which give the details as to various operating conditions in the last decade incidental to handling and carrying freight.

The principal result herein enumerated is set forth in the fact that for 1912 these railroads were able to carry in each freight train an average load of 510 tons, while the average in 1903 had been but 391 tons.

This achievement was one of the results of the fact that the 49 railroads in the territory affected expended during the past ten years an average of $200,000,000 a year in enlarging the roadbed and equipment. The increase in the property investment account per mile is due to many things—larger and more expensive terminals and stations for both passenger and freight; elimination of curves, grades and crossings; heavier and improved bridges, rails, ties, signals, interlockings, etc., and generally a more substantial standard of roadbed to carry the heavier equipment.

The railroads also have built larger locomotives. The average locomotive in service in 1912 had grown so in size and power that it could haul a heavier load by more than one-third—33.8 per cent., to be strictly accurate—than the locomotive of 1903. This meant that two locomotives in 1912 could almost do the work of three average locomotives a decade earlier. This is expressed technically in the statistical fact that tractive power of locomotives on these roads increased from 22,796 pounds in 1903 to 30,501 pounds in 1912.

As the engines increased in size so did the freight cars. The average freight car in use in 1903 could carry a little less than 31 tons.

In ten years the capacity of freight cars increased to 39½ tons—a gain of more than 9½ tons. At present three freight cars can carry almost as much as four could have carried in 1903.

Every freight car with any load in it carried 19 tons of freight on an average in 1903. This had increased to almost 23 tons in 1912, or short of 20 per cent. That is, five loaded cars in 1912 were doing the business of six loaded cars in 1903.

The average number of cars in each freight train—loaded cars, empty cars and cabooses—increased in this period from a train of 30.3 cars to one of 34 cars. While the number of loaded cars in each freight train was 20.7 in 1903, it was 22.4 in 1912.

The result was that these railroads in 1912 carried 15 tons of freight on an average on every freight car hauled—loaded or empty—when they had only carried 13 tons in 1903, an increase of two tons on each freight car moved, in the decade.

Wireless Signals.

Since the first wireless telegraph message from a moving train to a fixed station was flashed from the fast Lackawanna Limited to Scranton, Pa., two months ago, improvement of the wireless service between trains and stations for commercial and operating purposes has been steadily going on. L. B. Foley, the Lackawanna's superintendent of telegraph, who originated the idea of the train wireless system and has been in charge of the tests, is making satisfactory experiments in fields hardly thought of when the new use of wireless was first conceived.

The latest accomplishment is the setting of signals by wireless from a moving train or from a fixed wireless station and there is no longer any doubt that the wireless could be depended upon for the signal service. If an operator at a station wants to set a signal for a moving train not in communication with him he can cause the semaphore blade of the signal post to rise or fall as he wishes by simply sounding the proper dots and dashes on the key. There is a selective device by which an operator can set a signal at any point if he has occasion to flag a train.

Mr. Foley states that the service can be put into operation without increasing the train crews. Regular trainmen can easily learn the telegraph alphabet or telegraph operators on trains can perform the duties of trainmen. Later, it may be found necessary and profitable to place a telegraph operator on limited

trains running long distances without stopping to handle commercial telegrams for the public. Telegraph offices on trains in the future may be of as much value to the public as branch offices in hotels and other places where people congregate in large numbers.

Commercial telegrams have already been sent from the Lackawanna Limited and a set of regular toll rates is now being prepared by the railroad and telegraph companies.

Fashions First.

Just as the numerous and well-organized Safety Committees are making considerable headway in reducing the number of accidents on railways, the women continue to come along in all the steel-clad panoply of hobble skirts and high heels, and are responsible for an increasingly large number of injuries sustained by them while getting on and off trains, and mounting and descending stairways in stations.

A careful record kept for three months of all injuries sustained by women, due to slipping, stumbling or falling while on the property of the Pennsylvania Railroad, indicates that these accidents are becoming more rather than less frequent, despite the fact that the railroad company has repeatedly called the attention of its women patrons to the number of accidents caused by hobble skirts and high heels. The average number of accidents from these causes exceeds forty-five each month on the road referred to, and a corresponding ratio exists over the entire country. Of course a serious accident may be more lightly borne than the idea of being out of the fashion, just as death in some cases is better than dishonor. The only consolation is that these absurdities in apparel soon change, and it is to be hoped that the next set of fashionable freaks will be less dangerous to life and limb.

Fire Heat and Steam.

When men begin to think about the work they are engaged upon, it seems natural that they should keep searching for a familiar description of the principal apparatus they are accustomed to handling. This appears to be the reason why this office receives so frequently the question: What is the easiest definition of a steam engine? The most succinct answer to that question is, the steam engine is an apparatus designed for the purpose of converting the energy of heat into mechanical work.

The heat used for the production of power is nearly all generated by the combustion of fuel, mostly coal, oil and wood. Ever since men began to think and attempt to explain natural phenomena there have been discussions concerning fire and the nature of heat. Fire was said to be one of the most precious gifts of the gods, given to man alone that he might continue to be the most powerful ruler in the world. The fable concerning fire tells that man being the creature of Prometheus who, desiring to endow as well as create the human race, stole up to Heaven with a bundle of birch-rods, and kindling them at the sun, brought down the fire to the earth for the use of mankind. This fable was, of course, all nonsense, but it served in the days of universal ignorance to make people appreciate the benefits they derived from the use of fire.

The wise men of all ages have speculated about the nature of fire and heat, the belief being long entertained that heat was a subtle fluid devoid of weight that entered into bodies with comforting effects. The common occurrence of the lid of a kettle being forced up by the steam generated by the heat of the fire made thinking people conclude that the steam might be compelled to perform mechanical work if the proper harness could be devised.

About 300 years before the Christian era Alexander, the great Macedonian conqueror, built the City of Alexandria in Egypt, which soon became the headquarters of Oriental learning. Here such men as Euclid, Archimedes, Ptolemy and other scientists engaged in searching out the secrets of Nature. Some of them must have found the means of harnessing steam and making it perform mechanical work. That would be done to display knowledge, not to aid in helping to carry the burdens of mankind, for the philosophers considered anything of a utilitarian character to be vulgar. Some progress must, however, have been made, for about 150 B. C., a writer named Hiero described several appliances known in his time whereby steam might be employed as a motive power. The principal of these is the Æolipiles, which was susceptible of a fair degree of efficiency.

As the ancient world represented by the civilization of Egypt, Greece and Rome displayed no interest in developing the utility of the steam using apparatus, it become merely a curious toy. With the evil times that overtook the world culminating in the fall of the Roman Empire interest in the development of the steam engine was crushed out of men's minds for ten centuries.

The noted philosopher, Lord Bacon, who was born in 1561, was familiar with the Æolipiles and made some feeble attempt to develop the apparatus, but he did not possess the inventive faculty. The possibilities of steam were, however, becoming the subject of speculation in Bacon's time and during the sixteenth century Joseph Branca, an Italian, invented a sort of crude steam turbine, which would have made an efficient user of steam in the proper hands.

From that period speculation concerning the application of steam became a favorite subject with mathematicians and scientific investigators. It became the fashion to invent steam using apparatus, and many curious productions were offered to the industries that were suffering for want of power cheaper and more efficient than the strength of animals.

The industries that suffered most seriously through want of cheap power were the mines in Great Britain. Rich coal mines, copper mines, and tin mines were drowned out of use and their necessities brought the steam engine. After learned men philosophers and ingenious mechanics had labored for many years on the scheme of devising a steam engine that would do the work of pumping water more cheaply than horses, an unlearned blacksmith performed the feat successfully. He applied a piston to a cylinder which operated a pump lever and gave such improvers as James Watt a practical invention to work on. The inventor's name was Thomas Newcomen.

Spreading Railroad News.

Since the advent of Mr. Howard Elliott to be head of the New Haven system of railroads an organization has been established which is spreading valuable information concerning railroad matters to all the confines of the reading public. This Information Bureau is in charge of Mr. Edward G. Riggs, located in the Grand Central Terminal, New York, who does not confine his activities to the New Haven system, but makes the range of news universal. The efforts of railroad officials to induce the Interstate Commerce Commission to increase freight rates has been profusely reported and has been varied by a report on raising onions in New England. The mixture is very stimulating and is a pleasant change from the "no information given out" policy of days gone by.

Our office boy has become so keenly interested in the New Haven bulletins that he is ambitious to enter the business of onion raising.

From Hudson Bay to Strait of Magellan.

A railway extending from Hudson Bay to the Strait of Magellan promises before long to be the realization of a dream which has for many years appealed to the imagination of practical men who delight in conceiving of the difficult, but possible as being actual. The conception of a Pan-American railroad, extending from the Antarctic Ocean to the Arctic, illusory as it at one time seemed, is no longer regarded an idle dream, but as a practical project to be realized within a few years.

A railway is now being constructed which, when completed, will make it possible to travel by rail from Hudson Bay

through Canada and the United States to Central America. In the no distant future a railway will pass through Central America, across the Isthmus of Panama, and continuing will connect with the great system of South American railways clear to the Strait of Magellan.

Last month a long link in this chain was completed when the rails were joined of the great longitudinal railway in Chile from Iquique to Puerto Montt. This line extends for about 1,850 miles, and when completed it will extend from the frontier of Peru to the Strait of Magellan. The line just opened by Chile forges an important link in the chain which will ultimately unite Hudson Bay to the most southerly point on the South American continent, and make actual the dream of an Arctic-Antarctic railroad.

During the past four years the Pan-American Railway Committee, interested in this project, has received support from the International Bureau of American Republics as well as from the State Department at Washington, the several Governments concerned recognizing the advantages that must accrue from the success of the enterprise. Some of the Latin Republics have gone so far as to offer special inducements to capitalists for the promotion of the Pan-American railway scheme. One of the chief aims of the committee has been the joining of New York and Buenos Aires, a total distance of 10,116 miles. Of this 6,444 miles of railroad have been completed.

Politically and socially, the completion of so vast a scheme of railway construction can scarcely fail of being a beneficent influence in the lives of the divers nations brought into more intimate relationship by its means. The different nations north and south will came to understand each other better, mutual sympathies will become developed, and, even if racial characteristics breed differences, they will conclude to be friendly, even if they disagree.

The South American republics are becoming year after year less inclined to revolutionary escapades, and even Mexico will finally quiet down, and prefer something in the way of government, more suited to a free people, than mad displays of passion and the tyranny of the mob.

Improving the Highways.

Until automobiles became numerous, there was very little sentiment in the United States to favor the improvement of country roads. The only interests demanding improved highways were farmers and they failed everywhere to carry on combined efforts so their influence was unfelt. The most important performances on road improvement were carried out by railroad companies in the mending of roads that country produce could be carried over on its way to railroad shipping points.

Since automobiles became numerous constant agitation has been worked up favoring improved highways and the results have been marvelous. Figures compiled by the office of Public Roads of the Department of Agriculture in Washington, show that the expenditures in the United States for improvements on roads have more than doubled since 1904. In 1904 expenditures for this purpose amounted to $79,771,417, while in 1912 the total was $164,232,265, or an increase of $84,450,945.

It is shown that the greatest progress in road construction took place in those states that aided in the work by appropriations out of their state funds. In 1904 there were thirteen states that contributed $2,607,000, while in 1912 there were thirty-five states that appropriated to the extent of $43,757,438.

The expenditures for this purpose in 1912 amounted to $74.65 per mile, which was double that of 1904, when the per mile outlay was $37.07. The states having the largest expenditures for state aid and trunk line roads in 1912 were: New York, $23,000,000; Pennsylvania, $4,000,000; Maryland, $3,370,000, and Connecticut, $3,000,000.

Curiosities of Combustion.

In the combustion of fuel there is something analagous to the production of power through a water wheel. The amount of power that a water wheel can produce depends upon the degree of fall of the driving water. The amount of heat liberated by the combustion of a given quantity of carbon or hydrogen is mainly dependent upon the initial and final temperatures and densities of the combining elements. It is an invariable quantity for any given condition and is quite independent of the rapidity of combustion. The several values have been determined experimentally by several scientific investigators.

One pound of gaseous hydrogen, on entering into combustion with eight pounds of gaseous oxygen, both being at atmospheric pressure, density and temperature, and falling to water at about the same temperature, liberates a quantity of heat equal to about 62,000 heat units. It will be understood that the combustion of oxygen and hydrogen forms water and produces the highest temperature connected with combustion.

Solid hydrogen is present in coal and its combustion with oxygen and is supposed to create about 50,000 heat units to the pound. When, instead of falling to water at 60 deg. Fahr., the products of combustion form steam at atmospheric pressure, the two heat values are reduced about 10,000 heat units in each case.

One pound of gaseous carbon on combining for combustion with 2 2/3 pounds of gaseous oxygen to form gaseous carbon dioxide, the initial and final temperatures and densities being about those due to atmospheric pressure, liberates about 20,000 heat units. Free gaseous carbon is not found, but its hypothetic thermal value is approximately stated.

One pound of solid carbon on combining with gaseous oxygen and forming carbon dioxide, usually called carbonic acid, produces about 14,500 heat units. When one pound of solid carbon is burned in conditions where the air supply is restricted, it combines with 1 1/3 pounds of oxygen and forms carbon monoxide, which generates about 4,500 heat units. The carbon mon-oxide has about 1,000 heat units less than the carbon dioxide formed when a full supply of oxygen is present.

It is well for enginemen to remember the steam making difference between coal burned to carbon dioxide and that burned to carbon monixode. The same weight of fuel would be burned in both cases.

Railroad Accounting By Machinery.

One of the great transcontinental railroads finds it necessary to refer repeatedly to traffic statistics in connection with rate litigation and kindred subjects. The volume of traffic on this road is such that complete reports of this character could not be obtained except at enormous cost in both time and money were it not for the fact that all traffic statistics are analyzed regularly by means of the punched card tabulating system.

This road reports the present plan of analysis to be so much more extensive and elaborate than before the tabulating machines were put in several years ago that no direct comparison can be made between present and previous costs of obtaining regular audits. It is estimated, however, that the present results in routine work without the aid of the machines would cost from 50 to 75 per cent. more than they do now.

But, under the old system, "We would not be in a position to answer the numerous requests for special information, called for by various officials and demanded in connection with rate litigation, without enormous cost. The cards adapt themselves readily to almost any kind of special information required, in addition to the regular tabulations. This makes additional information available on short notice—something practically impossible under any other system."

This road makes enormous use of the machines in routine work. Under traffic statistics statements are prepared showing tons, ton-miles and earnings by 88 different commodities for each of the fourteen states through which the line runs. Figures for interstate traffic are separated from those originating and ending in one state. Information called for by the various state commissions and the Interstate Commerce Commission, relating to the classifications of tonnage are compiled in connection with these tabulations.

From freight train cards is produced a statement showing the various classes of ton-miles by operating divisions, taking main lines and branch lines separately. This information is used in determining unit cost of operation. The cards are used also for compiling gross ton-miles by each individual locomotive, these figures giving ultimately unit costs and comparisons between separate locomotives and also as to various classes of lomomotives.

In this way information is obtained which determines in a measure the policy of the company with regard to types of locomotives ordered. Those types which show excessively high cost for their work are not repeated. In many cases it is possible by combining certain characteristics of different types to reach that one which is, everything considered, best suited to the work in hand.

Accidental Inventions.

Our women friends who are striving to secure equal rights with men generally assert that women are equal to men and a little better, but the gentle sex seems to fail when they come into even competition with men. This is strikingly true respecting the inventive faculty.

In the Patent Office Record there are to be found nearly every week descriptions of new inventions intended for household purposes and for the lightening of women's domestic duties, yet the greater part of them are the inventions of men. Occasionally, however, a woman invents a useful article and, curiously enough, most of such inventions have been suggested by accident. The invention of colored paper, for instance, was the work of a Mrs. Eastes, as thus told by the *Globe-Democrat*:

"She was the wife of William Eastes, one of the leading paper makers of England in the eighteenth century. In passing through the paper plant one day she dropped a big blue bag into a vat of pulp. Eastes was a stern chap, and so, since no one had seen the accident, Mrs. Eastes decided to say nothing about it.

"The paper in the vat, which should have been white, came out blue. The workmen were mystified, Eastes enraged, while Mrs. Eastes kept quiet. The upshot was that the paper was sent to London, marked "damaged," to be sold for whatever it would bring.

"The selling agent in London was shrewd. He saw that this blue tinted paper was attractive. He declared it to be a wonderful new invention, and he sold it off like hot cakes at double the white paper's price.

"Eastes soon received an order for more of the blue paper—an order that he and his men wasted several days in trying vainly to fill.

"Then Mrs. Eastes came forward and told the story of the blue cloth bag. There was no difficulty after that in making the blue paper. This paper's price remained very high, Eastes having a monopoly in making it."

Are Trainmen Becoming Careless?

In his very interesting book on Railroad Accidents, Charles Francis Adams made the assertion that the American locomotive engineer with no facilities for conserving safety could take his train over the road without accident under conditions that would invite disaster in any other part of the world. The author of that book held the opinion that if our railroads were equipped with the safety appliances to be found on European railways, there would be no railroad accidents in America. The book was written before the Miller platform and buffer, the Westinghouse air brake and the interlocking signal system had come into general use on our railroads, and while railroad managers were still arguing that safe operating depended entirely upon the ability and care of trainmen.

The railroads of New England had been fairly exempt from serious train accidents, although operated with no respect for safety appliances. In 1871, however, a disaster at Revere, on the Eastern Railroad of Massachusetts opened the eyes of the people to the necessity for the introduction of the most approved methods and appliances. The accident happened on a Saturday in August while holiday traffic outstripped the facilities of a road where the operating was of the most blundering character. An accommodation train crowded with passengers was run into by an express train. The engine plowed its way through two cars, the steam connections were broken off on scalding steam and hot water aided the debris of the cars in killing twenty-nine persons and seriously injuring fifty-seven others.

That catastrophe stimulated the railroad companies of New England and indeed those in all sections to introduce safety appliances and methods, but their trainmen celebrated for their care and skill seemed to be retained with their vigilance and good sense unlimited. This made itself apparent in the succeeding seven years, for during the period from 1871 to 1878 only two deaths of passengers happened during a time that 230,000,000 passengers were carried.

Since that time the railroad companies have continued to equip their train service with every device calculated to promote safety. Automatic signals have been installed in every place where they could be depended upon to keep trains apart, but still serious collisions seem to increase in number and in violence. The recent report of the Interstate Commerce Commission says that it is again compelled to note the exceedingly large proportion of train accidents due to direction of duty on the part of employees and adds: "Fifty-six of the accidents investigated during the year, or nearly 74 per cent. of the whole number, were directly caused by mistakes of employees. These mistakes were of the same nature as those noted by the commission in its last annual report, namely, disregard of fixed signals, improper flagging, failure to obey train orders, improper checking of train register, misunderstanding of train orders, etc. The errors are exactly the ones which figure in the causes of train accidents year after year."

Are we to infer from this that the train operating men of today have lost the habits of care and vigilance for which they were noted in the long ago?

President Willard Presents Case of Railroads.

In presenting the case of the railroads to the Interstate Commerce Commission, Mr. Daniel Willard, president of the Baltimore & Ohio Railroad, made a masterly appeal for justice. He displayed a wonderfully intimate acquaintance with the situation, and in our judgment said everything calculated to convince the commission that an increase of rates was not only fair but absolutely necessary. Among other striking remarks he said:

"The railroads in Official Classification territory have increased their property investments for new tracks, stations, locomotives, freight and passenger cars, and for other similar purposes at the rate of approximately $200,000,000 per annum during the whole of the last ten-year period, and it is certain that the continued annual expenditure of a sum even greater than that will be necessary for similar purposes if the carrying capacity of the railroads in this territory is to keep pace with the normal growth of commerce.

"The immediate and all-important question is, How shall these railroads obtain the new capital necessary if they are to provide the needed facilities and furnish the high-class service which the public interest demands, and to which the public is properly entitled?"

While using the ordinary scoops employed in firing locomotives and similar furnaces, each scoopful represents from 12 to 15 pounds of coal. Bituminous coal is slightly higher than anthracite. A solid cubic foot of anthracite coal weighs about 93 pounds. When broken for use it weighs about 54 pounds to the cubic foot. Bituminous coal when broken up for use weighs about 50 pounds to the cubic foot. This rule ought to be familiar to every householder who stores coal for winter use.

For the approximate measurement of coal in a bin or box is to multiply the length in feet by the height in feet and again by the breadth in feet, and this result by 54 for anthracite coal, or by 50 for bituminous coal. The result will equal the number of pounds, and to find the number of tons, divide by 2,000.

Catechism of Railroad Operation

NEW SERIES.

First Year's Examination.

(Continued from page 392, December, 1913.)

Q. 60.—How would you care for a boiler with leaky flues in firebox?

A.—I would keep the fire burning brightly over its entire surface, and would not allow the firebox door to remain open any longer than possible while putting fuel on the fire.

Q. 61.—What is meant by "atmospheric pressure"?

A.—It is the weight of the air on the earth's surface, which is 14.69 pounds per square inch, but is ordinarily spoken of as being 15 pounds per square inch.

Note.—The air or atmosphere which we breathe surrounds the earth to a heighth of about forty-two miles, and a column one inch square bears down on the earth's surface at sea level with a pressure of 14.69 pounds.

Q. 62.—What do you understand by the pressure registered on the steam gauge?

A.—It is the pressure in the boiler above atmospheric pressure.

Q. 63.—What is absolute pressure?

A.—It is the pressure indicated by the steam gauge plus the atmospheric pressure.

Note.—Thus, Gauge pressure 180 pounds plus atmospheric pressure 14.69 pounds equals 194.69 pounds absolute pressure.

Q. 64.—What is the source of power in a steam locomotive?

A.—Heat in shape of steam.

Q. 65.—What quantity of water should be evaporated by one pound of coal?

A.—From seven to eleven pounds, but the average amount evaporated is about five pounds to one pound of coal.

Note.—One gallon of water weighs 8.355 pounds.

Q. 66.—What is steam? How is steam generated?

A.—Steam is water turned into a vapor by generating heat with a fuel in the firebox, the heat is radiated through the metal sheets of the firebox to the water, turning the water into a vapor.

Q. 67.—At what temperature does water boil in an open vessel under atmospheric pressure?

A.—At 212 degrees Fahrenheit.

Q. 68.—Does it require a greater temperature to boil water under a pressure of 200 pounds? If so what temperature is necessary to boil water under 200 pounds pressure?

A.—Yes. It requires a temperature of about 387 degrees Fahrenheit to boil water under 200 pounds pressure.

Q. 69.—About what should be the height of water in the boiler when all is in readiness for starting on the trip?

A.—The water should be carried as high as possible at all times and not work it over into the cylinders, and should never get so low that the crown sheet will not be covered and protected.

Q. 70.—Can the firing be done more intelligently and economically if the water level is observed closely? Why?

A.—Yes, because if the water level is closely watched by the fireman, he can fire according to the needs of the boiler, and will not put in fuel at times when the injector has to be shut off, by doing which he would waste fuel and water by causing the safety valves to open and blow away steam.

Q. 71.—Why is it desirable that a uniform boiler pressure be maintained?

A.—Because it is better for the flues and seams in the boiler and it is far more economical in fuel and water consumption, and the engine will do the work required of her much easier.

Q. 72.—Is it any advantage for the fireman to know the grades on the road and the location of stations?

A.—Yes, because he will handle his fire properly and not waste fuel by putting in fires unnecessarily.

Q. 73.—What is the purpose of the safety valve on the locomotive boiler?

A.—The safety valve is a device to prevent the steam pressure from raising above a stated pressure for which the boiler is constructed.

Two and three safety valves are used on one boiler as an extra precaution, to guard against emergency conditions where the one valve could not relieve the pressure as fast as a heavy fire would generate it.

Q. 74.—What should be done to prevent waste of steam through the safety valve?

A.—The engine should be fired so that when the throttle was to be eased or shut off, the fire would not be so heavy that it would make steam fast enough to raise the safety valve, and a small amount of excess steam may be blown back into the water tank through the injectors, when necessary to prevent the safety valves being raised, dampers may be closed to check the flow of air through the ashpan and fire, excluding the oxygen, or the fire door opened a little will check the fire and cool the temperature of firebox and in that manner prevent popping.

Q. 75.—What is the estimated waste of fuel per minute when the safety valve is open?

A.—From fifteen to twenty pounds of fuel or coal is wated per minute while the safety valve is open, besides wasting water in large quantities.

Q. 76.—Is it not a waste of fuel or coal to open the firebox door to prevent safety valves from opening? How can this be prevented?

A.—Yes, it is a waste of coal to open the firebox door, but not so great a waste as would occur if firebox door were left closed and the safety valves opened and it can be prevented by the fireman knowing the road, watching the water level and firing accordingly, with either bituminous or anthracite coal. It is necessary that fireman and engineer work in harmony at all times to get best results.

Q. 77.—What should be the condition of the fire when passing over the summit of a long grade?

A.—The fire should be in condition to produce the steam necessary to work the air pump to maintain the maximum air pressures, and work the injectors to supply the necessary water to the boiler without losing any steam pressure or raising the safety valves.

Q. 78.—What should be the condition of the fire when approaching a station where a stop is to be made? When arriving at a terminal?

A.—The fire approaching a station stop should be bright and burned down enough so that the safety valves will not be opened, no black smoke be made or the pressures lowered or show any loss. At the terminal the fire should be left so that it will prevent cooling of firebox sheets and still not run the steam pressure up to open safety valves.

Q. 79.—What are the duties of a fireman on arrival at a terminal?

A.—To leave the fire in proper condition, see that there is sufficient water in the boiler to last until taken charge of by round house force, put the signal lamps and other appliances in proper condition and in their proper place (per rules for care of such part of the equipment), inspect for and report to the engineer any defects in the firebox or boiler attachments, so he can make report on work book and have repairs made.

Q. 80.—Do you thoroughly understand all the signals used on the road?

A.—Yes.

Q. 81.—Are you required to render assistance to the engineer while on the road and your other duties are performed? What assistance are you to give?

A.—Yes. I am to help the engineer perform any necessary work possible, to insure a successful trip and avoid delays to train

Q. 82.—What is the fireman's duty while on the road, and not working with fire?

A.—To be looking ahead for signals or obstructions on track, and watching train for hot boxes or other defects to cars which might cause accident.

Q. 83.—Describe the various signals, and give their meaning.

A.—The hand, a flag or light swung across the track means stop. The hand, flag or light raised and lowered vertically means to proceed or go ahead. The hand, flag or light swung vertically in a circle at half arms length across the track, means to back up. The hand, flag or light swung vertically in a circle at arms length when the train is moving, means that the train has parted, or broken in two parts. The hand, flag or light swung horizontally above the head, when train is standing, means to apply the brakes to try them to see that they are operative. The hand, flag or light held at arms length above the head when train is standing, means to release the brakes. Any object waved violently on or near the track, by any one, is a signal to stop at once and indicates danger. A red flag or light displayed on track, or near right side of track, means stop at once, danger beyond. A blue flag or light displayed at one end or both ends of an engine, car or train, indicates that men are working there, and when thus protected must not be coupled on to or moved until the one placing the signal there has taken it down and removed it. A fusee on or near the track burning red means stop and it must not be passed until burned out. A fusee on or near the track burning green means proceed with caution, with train under control so it can be quickly stopped. One short blast of the whistle means stop. two short blasts of the whistle, means I see, in answering signals. Three short blasts of whistle when train is standing, means I will back train or is an answer to hand or lamp signal to back train. It is also the answer to air whistle signal to back train. Four short blasts of the whistle calls for a signal or means "what do you desire." It also is used to call for the switch tender to throw a switch. Two moderately long blasts of the whistle means release the brakes. One long and three short blasts of the whistle means for the flagman to protect the rear of train. Four long blasts of the whistle calls in the flagman from the west or south. Five long blasts of the whistle means for the flagman to return from the east or north. Three blasts of the whistle when train is running means that the train has parted. and is used in reply to the hand signal given by train men when train has parted. Two long and two short blasts of the whistle is the grade crossing signal. One very long blast of the whistle is signal approaching stations. One torpedo exploding means stop. Two torpedoes exploding near together is signal to proceed with caution at reduced speed with train under control looking for signal to stop.

Q. 84.—In addition to any that you have mentioned, what do you consider a danger signal?

A.—Any signal improperly displayed, or lights not burning on a regular signal.

Q. 85.—If you discover that a fixed signal is missing or imperfectly displayed, what is your duty?

A.—To notify the engineer at once.

New Railroads in East Africa.

An event of great economic importance will be realized early in 1914 by completion of the Central Railway in German East Africa. Construction was begun in 1904 and completed to Tabora, 530 miles from the seaboard terminal, in February, 1912. The railroad when completed will extend 786 miles—from Daressalam, on the Indian Ocean, to Kigoma, on Lake Tanganyika.

The line divides the German colony into two equal areas, thus making a trunk system from which branches may be built over a great part of the colony. A vast and productive region is thus opened for establishing plantations. It will also become the outlet for the broad hinterland in which lies Lake Tanganyika, with its 400-mile stretch of navigable waters, tributary to which is a rich commercial region in the heart of Africa. Along the extensive shore of this lake products will be gathered and distributed by a fleet of ships co-operating with the railway.

German East Africa, with its area of 384,000 square miles and population of 10,000,000, is certain to respond to the economic advantages created by the completion of the Central Railway. Great areas of wild land will be brought into modern cultivation, in which large capital will be invested, new mineral regions and forest areas will be exploited, public highways will be extended, and to the millions of natives will be brought the commodities of more advanced nations.

Favor Enlarged Cylinders.

From the result of tests made by connected superheater locomotives, the test department of the Pennsylvania Railroad concluded that any locomotive on being converted from saturated to superheated steam should with the application of the superheater have enlarged cylinders. The results noted indicated that for the purpose of obtaining maximum economy the extent of the cylinder enlargement should be such that the maximum indicated horsepower may be developed at a cut off not exceeding 30 per cent.

Baltimore & Ohio.

The forces in the Mount Clare shops of the Baltimore & Ohio Railroad all returned to work after a few days' lay-off of some of the workmen during the last few days of the month, which was occasioned by a catching up in the repair work. Officials explained today that at the end of the month it is sometimes necessary to reduce the working forces in the shops on account of completion of repair jobs, but that the mechanics and other workmen in the various shops on the system are back at their places of employment with the beginning of the present month.

Latest Turbines.

Wonderful turbines will drive the mammoth Cunarder *Aquitania*, which is now being completed at Clydebank They have a total weight of 1,400 tons, and to enable them to be lowered into the hull of the ship, one of the four great funnels could not be placed in position There are more than a million turbine blades, the combined length of which is more than 140 miles. The blades vary in length from one and a half to twenty inches. These turbines are absolutely the latest production of marine engineering.

Rapid Bridge Work.

A steel bridge was recently removed and replaced by another, near Victor, N. Y., on the Lehigh Valley Railroad in the remarkably short space of five minutes, and without any delay in the traffic. The new bridge which was put in place complete, even to its ballasted tracks, is a plate-girder structure, with a span of 103 feet. The main girders are 10 feet in height, and it has a solid concrete floor. This mass was rolled into place in three minutes and was ready for immediate use. The old bridge was rolled out of the way in a minute and three-quarters.

Longest Railway Tunnels.

The world's greatest tunnels are to be found in Europe, and a brief summary of these in the *Engineer* shows that the greatest is the Simplon, which is 12¼ mile in length. Two, the St. Gothard and Lotschberg, are over 9⅓ miles in length. The Mont Cenis is a little over 7 miles in length. The Arlberg, in Austria, is 6¼ miles long. There are four tunnels between 5 and 6 miles in length, five between 4 and 5 miles in length, seven between 3 and 4 miles, and sixteen tunnels that are over 2 miles long. The longest tunnel in this country, the Hoosac, is 4⅓ miles long. It may be added that there are several longer tunnels in the course of construction, but they will not be finished for several years.

General Foremen's Department

Erie Apprentice Schools.

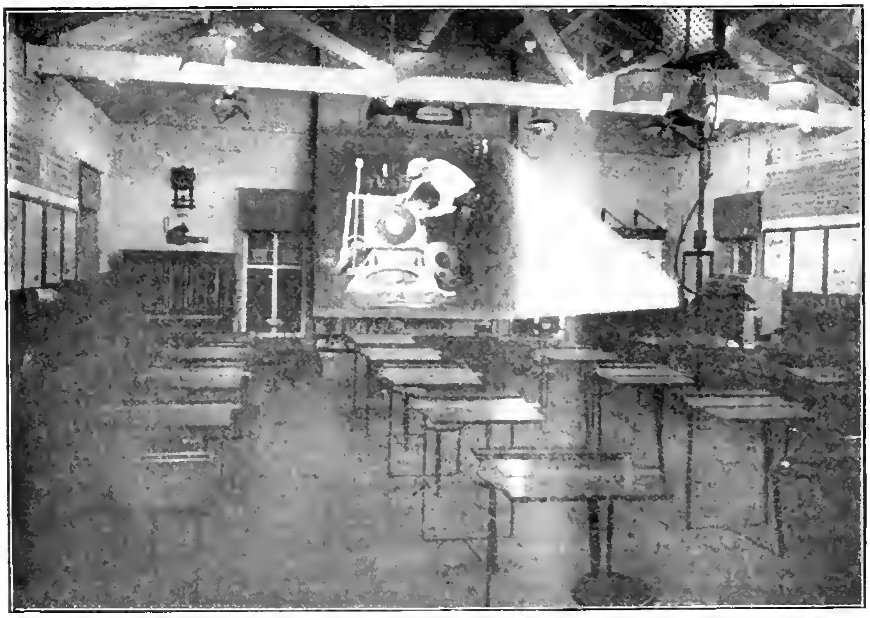
By Angus Sinclair, Special Instructor.

The Erie Railroad Company maintains schools for the technical instruction of apprentices at five of their repair shops, an arrangement which is cultivating a high standard of mechanical and scientific efficiency among a class of young men who are being prepared to become leaders in their business in the near future. The company, in the establishment of apprentice schools at its different shops, has for its primary object the making of first-class skilled mechanics to recruit the shop forces with men trained and educated in Erie standards and methods.

The company furnishes class rooms, properly heated and lighted, with drawing instruments, drawing tables, blackboards and all necessary material needed in the line of instruction, all of which is supplied free to the apprentices.

The plan of organization is: First.—A supervisor of apprentices. Second.—An assistant supervisor of apprentices. Third.—A technical instructor for all shops having fifty or more apprentices. Fourth.—A practical instructor for all shops having fifty or more apprentices. Fifth.—A man possessing technical knowledge and practical ability to instruct in shops having less than fifty apprentices.

In the selection of apprentices for employment in Erie shops preference is given to sons of employees. The candidate must be of the age between sixteen and twenty-one years, enjoying good general health. Applicants addicted to the cigarette or other unhealthy habits are at once invariably rejected.

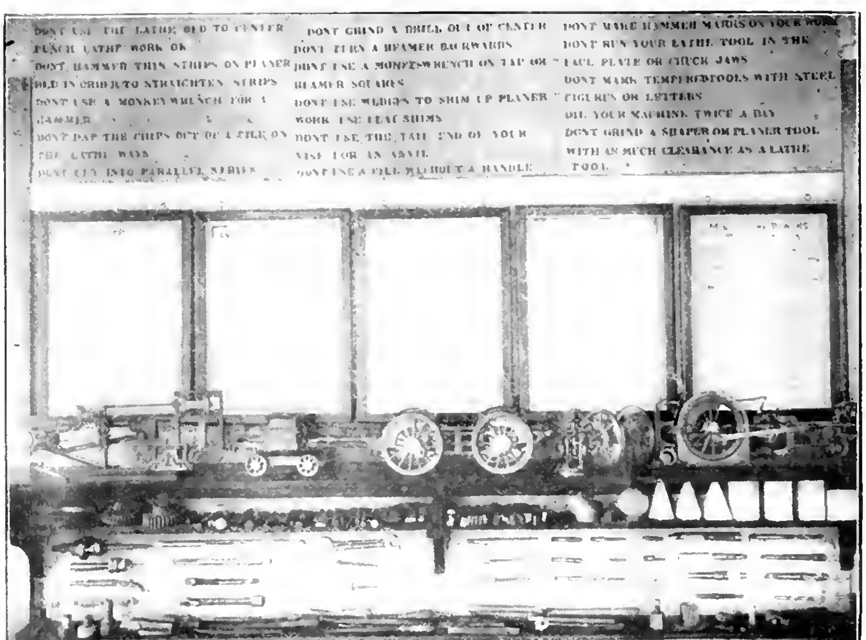


USING STEREOPTICON TO SHOW WORK OF AN APPRENTICE

The lines of work to be followed in the various departments are all scheduled and followed as can be done conveniently in the interest of the apprentice and of the company, the leading aim being to produce efficient workmen capable of supervising shop operations.

There are eleven divisions of apprentices, viz.: Machinists, blacksmiths, boiler-making, tin and pipe shop, painters, electricians, car builders, cabinet makers, carpenters, patternmakers and moulders. The machinists serve four years and each of the other trades three years. The machinist apprentices have a much more comprehensive line of training than the others. The former course involves instruction concerning standardization of work, shop and class efficiency, practice on lathes, planes, shapers, slotters, boring mill, vise work on rods, vise work on motion, pistons, crossheads, etc.; erecting shop operations, tool room, air brake department, surface table and machinery repair gang.

The different scientific instructors are left largely to follow the methods which they consider most likely to impart practical information to the apprentices. The annexed engravings are reproductions of illustrations and models used by Mr. H. E. Blackburn, instructor of the Apprentice School at Dunmore, Pa. They are the means of giving instructions on various lines of work and are much more effective than the shop operations. In fact, they are a useful means of making shop operations and action of shop tools comprehensible to the average young man.



SPECIMENS OF ORDINARY WORK.

From what I have seen in a great many apprentice schools on the Erie Railroad and other places, I think Mr. Blackburn's methods are the most effective of any I have studied.

Why Some Apprentices Fail.

H. E. Blackburn,
Apprentice Instructor, Erie R. R.

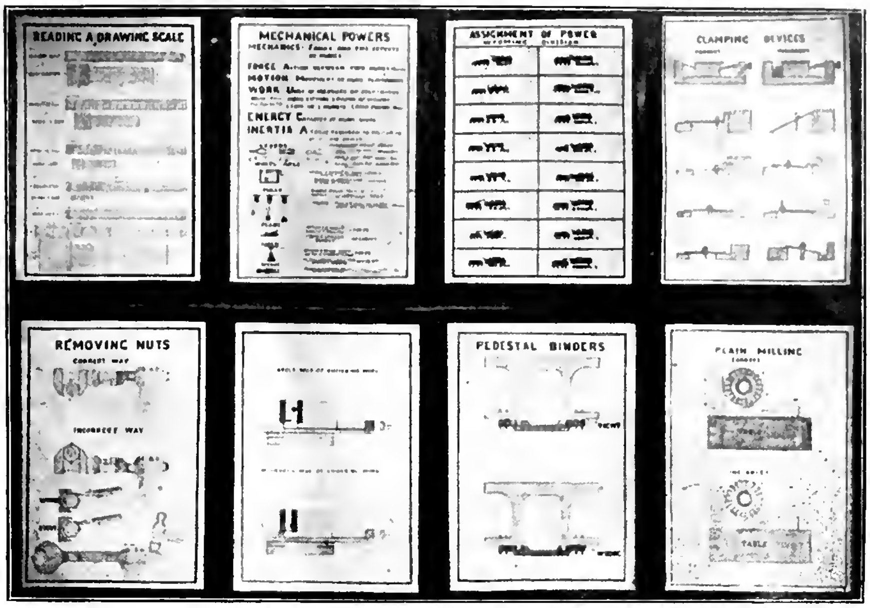
There are two ways of learning a trade, one is to do as you see others do, the other is to know the reason why. Most boys display an inquisitive streak about the home that taxes the minds of their parents to the limit, but just as soon as they are seated in the class room this good trait vanishes and gloom in large quantities enters the boy's head.

The pouring in method of teaching the boys orally, or from a text book, was supposed to fill his head full of crammed knowledge and whenever the teacher had a "grouch" he would "quiz" the boy he liked least to see how little knowledge he had retained; the result generally was that it was "after school for the boy." This is where the boy gets in as a vicious kid, with this very unnatural way of teaching.

Edison, the wizard, has devised a sort of school work to be projected on a screen by the moving picture machine that is calculated to supply a great amount of interest with the total absence of unpleasant solitude so often found in the class room. The fact is you will have to drive the boys home instead of to the school if the rule of the "movies" holds good.

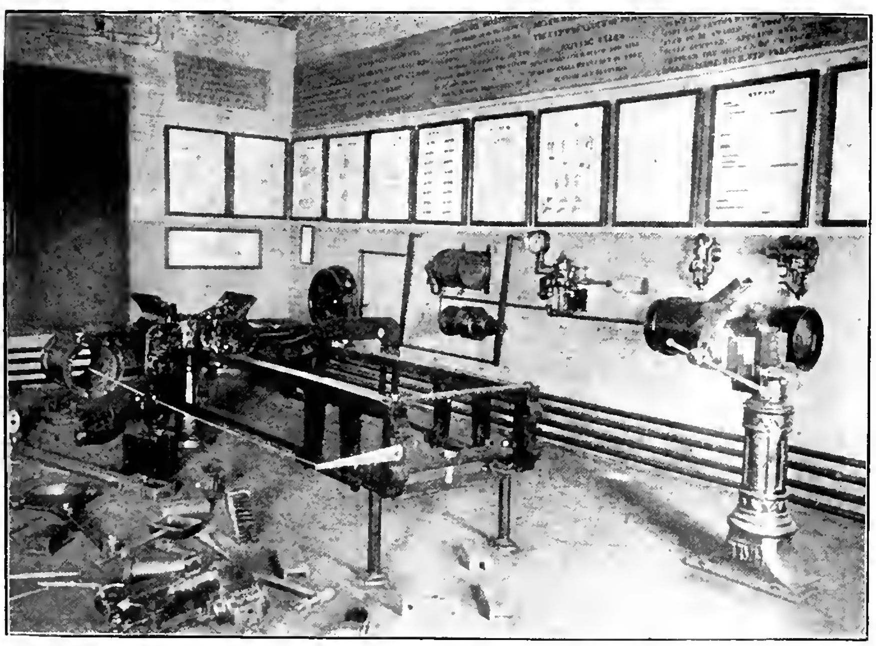
These pictures tell freely what impresses the boy most, or what fails to "get across" during the study hour at school with books. The films are records of clever subjects worked up by the Wizard himself, and "leave it to Edison" is a good motto when it comes to solving any great question.

Pumps having glass cylinders that show the water rushing in and out through the valves is one of the many subjects taken. The entire Bessemer steel plant is shown in miniature, and every actual detail is shown between clear printed descriptions of the part demonstrated so that nothing is left to the imagination.



ILLUSTRATIONS OF CORRECT AND INCORRECT.

Manual work is assisted to the extreme with the aid of the moving picture machine and a great many colleges are using them to help out in vocational work. In the State of Wisconsin it makes book drudgery all play for the boy, and life worth living for the teacher.



STRIKING CENTER LINE OF CYLINDER, AND VARIOUS MODELS.

Too much "movies" is as bad as too many books. It is the aim to show the pictures at the time the book fail to interest the scholars. A relaxation, that is all, but a most beneficial one for the boy, for he is becoming educated unknown to himself.

H. E. Mills states in the "World's Work" for October that he is trying to make it possible for every boy who leaves the public school at 16 to continue his education while working, if he is compelled to leave school in order to help out at home, by following some trade of his liking. This is the correct spirit or education that counts, or applied education for the poorer class.

In order to do this it will be necessary to upset the present form of education in the public schools, where two million children between the ages of 14 and 16 are out of school every year. At the present time only one million seem to be able to qualify for the trades or any vocational work, just because the school did not hold their interest and their parents had become tired of insisting on their attendance at school. Most of these children are of the sixth grade.

The State of Wisconsin gives free vocational education to 27,000 children five hours each week and it only costs $5 per year for each scholar.

This special continuation vocational school system is solving in a simple manner the biggest educational problem before the public taxpayers of the United States, who pay $500,000,000 a year now for inadequately trained, out-of-date teachers under the delusion that they are thus providing for the future education of the youth.

Of course, the free night schools help out in the large cities, but how about the towns where the free night school is unknown? The night schools keep some of the children off the street, but what is wanted is some school that will keep them

all off the street entirely, for statistics show that 85 per cent. of the children from school go into the "blind alley jobs," such as selling papers or working in the textile industries. These jobs never pay a mechanic's wage. What is wanted in America today are young men who can do things with their hands, guided by their brains, not the young college untrained man who can tell you how it should be done, according to the book. Ninety per cent. of the boys who leave trade colleges are walking the streets just because they lack experience, and it is pleasing to note that at the last meeting of the apprentice instructors on the New York Central Railroad they had come to the conclusion that the market was glutted with mechanical draftsmen and that they were going to cut drafting out unless some one boy showed unusual aptitude for the work. What they are after now is the development of skilled mechanics and these don't, as a rule, develop any bottoming chair traits. All that is needed in their education are a few rough sketches so that they can read a blueprint correctly. This is as it should be. The individual character of the boy should be studied also, for the best apprentices are those fitted to some one line of the trade, after they graduate.

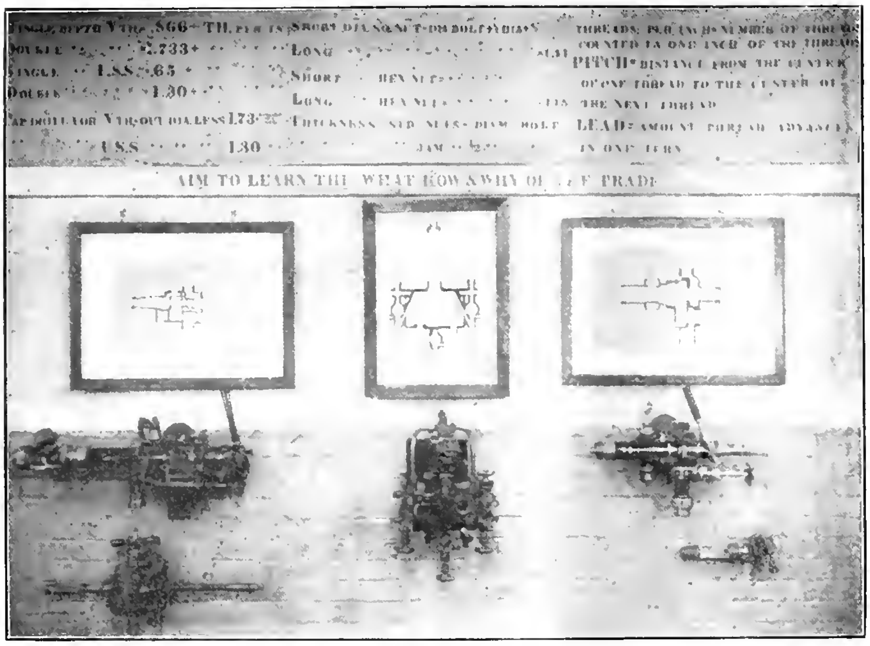
If the public school would sift out the trade boys the railroads and manufacturing firms would certainly take them in if they knew the first steps in the language of the shop, for school mathematics is not like shop mathematics by a long way. It is dead easy to work problems when you can see where they are to be applied, and the only place to find the teacher is from the shop force, one who has been to college if possible, but shop experience is a necessity.

Industrial schools don't aim to make apprentices for the shop alone, but trains them for all trade callings. It aims to fit the child, boy or girl, for their life work later on.

Some absent-minded children learn readily from books, they seem to have a kind of mental capacity for printed matter. This class represents about one-half of the scholars in school. The other half are scholars of the concrete mind variety who can only learn with difficulty any kind of book work.

Hand-minded children are those who fail in books, but are able to work out problems involving figures that are applied in the actual work. The point in view is that some boys like to play baseball and hate marbles while other boys like marbles and hate baseball. Now, why make either boy play the game he dislikes. Let him play the game he likes best, but teach him the best way to play the game.

If America is to lead the world in skilled mechanics it is time to conceive a proper system in order to educate the boys, then to inaugurate it and last to keep it up. The last is where most systems fail.



USEFUL INFORMATION GRAPHICALLY ILLUSTRATED.

APPRENTICES IN ERIE SHOPS AT DUNMORE, PA.

Oil Fuel.

That oil fuel has some very great advantages over the solid variety is hardly a subject for controversy, its many merits being too patent for dispute. It is much more easily handled and transported, a pipe-line providing a means of transport which, where possible, probably costs less even than by large oil-tank steamers, low though ocean freights may be. Many of its advantages remain, whether it be employed for generating steam or its energy be directly converted into power in an internal-combustion engine. An oil-fired torpedo-boat destroyer can be brought to rest for half an hour from a speed of over 30 knots with scarcely the loss of a pound of steam through the safety valves, and, when restarted, full speed can be attained again within a space of some 10 minutes. Stoking, moreover, ceases to be a laborious operation. In fact, the advantages are such that, were oil as readily available as coal, the latter would cease entirely to be utilised in ship propulsion. Unfortunately, however, the supply of oil by no means keeps pace with the demand, so much so that low cost of fuel is no longer claimed as an advantage for a Diesel-engined ship operating in any but special trades, or within any but particular and strictly limited area.

Wood Fireboxes.

We understand that the American Locomotive Company and the Baldwin Locomotive works have entered into an arrangement with the W. H. Wood Locomotive Firebox & Tube Company to apply their firebox under a royalty.

New Lunch Counter Car for the Pennsylvania Railroad

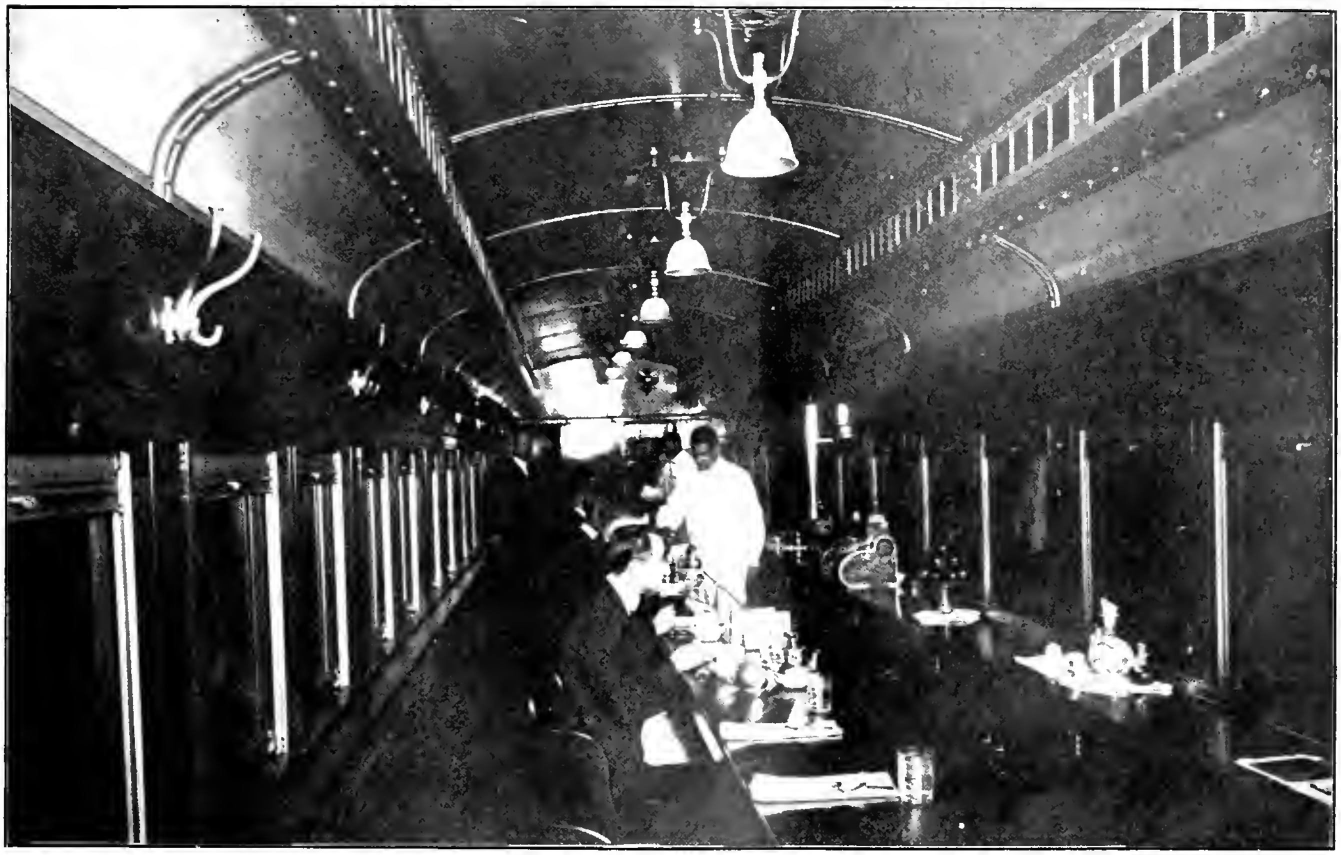
The Pennsylvania Railroad completed last month a new solid steel lunch counter car, and it is now in service between New York and Philadelphia, on trains which also carry ordinary dining cars. While the novelty of the counter car may for a few days prevent a fair comparison in the patronage of the two kinds of cars, it is planned to continue the experiment for a sufficient period to determine just which is more popular with the traveling public. The object in building the counter car was to see if it would permit of serving meals to passengers quicker—and thus serve satisfactorily more patrons—than is possible in a dining car.

The new car is 80 feet long, and the exterior appearance is the same as that of a Pennsylvania all-steel passenger coach. The interior is radically different from the ordinary dining car. Instead of tables there is one long mahogany counter extending over half the length of the car; facing this counter on one side are revolving mahogany chairs, secured to the floor. The counter is long enough for 21 people to be seated at one time. Back of the counter against the wall there are twenty cupboards for supplies, in addition to receptacles for crushed ice, drinking water, ice cream, milk and cream. Shelves for linen and silver occupy the space under the counter. Sunk in the counter at the end away from the kitchen is a cigar humidor. At one end of the car there is a wash basin for the use of passengers.

The pantry and kitchen are at one end of the counter. The pantry contains dish racks, cupboards, a sink and a locker. Food will be passed from the kitchen into the pantry through openings which can be closed by sliding doors. As these openings are just above the serving table in the pantry, there is no necessity for waiters to go into the kitchen. The kitchen itself is about 11 feet long; it contains a range, broilers, steam table, ice box, coffee urn, soup receptacle and meat warmer.

The interior of the car is finished in a mahogany color, the same as the dining cars. It is electrically lighted, and ventilation is aided by an exhaust fan and three large electric fans.

The car is in service on a train leaving Philadelphia for New York at 12 o'clock noon, as this train is usually heavily loaded, and a large number of the passengers as a rule eat their lunch on the train. The second trip af the car is on the train leaving New York the same afternoon at 6 o'clock. The quick service is being much appreciated.



NEW LUNCH COUNTER CAR ON THE PENNSYLVANIA RAILROAD.

New Military Railway Car in India.

The Bombay *Times* in a recent issue gives a description of a military railway carriage that has just been constructed at the new shops of the Great Indian Peninsula Railway at Matunga, in the Bombay Presidency. The original features of this new type of car are mentioned as follows: The body of the car is 68 feet long and 10 feet wide outside, built of Burma teak, on a substantial steel underframe. The construction adopted is novel inasmuch as in order to secure the largest possible cross section the body and underframe are incorporated as one structure. The adoption of the construction mentioned secures an extra 4 inches in the internal height of the coach without encroaching on the limited "loading gauge" of the Indian railway, while retaining wheels of standard diameter (3 feet 7 inches). The dimensions of this car practically represent the maxima permissible before the widening out of the trucks now in progress is complete.

The internal fittings consist of folding berths to accommodate 66 soldiers. These are arranged in three tiers on galvanized steel tubular framing, very similar to those of a troop ship. The rows of berths open off a side corridor 2 feet wide. Under the lower seats or berths are rifle racks, while above the uppermost are large parcel racks for the soldiers' kit, and lavatory accommodation is provided at each end.

Air Brake Department

Electric Operation of Universal Valve.

In last month's issue, the pneumatic operation of the single-cylinder universal valve for passenger cars was explained, and at the present time it is desired to comment upon the electric operation.

The electric operation for the single or double cylinder equipment is, of course, the same, and while the diagrammatic view shown is of the double, or two-cylinder arrangement, it is shown for the purpose of comparison with the valve shown last month.

The object of two cylinders per car is first, an efficient service brake with high maximum cylinder pressure and lower total leverage ratio and the greatest possible difference between service and emergency braking power or double braking power for emergencies. As service braking power is then based on an 86-pound brake cylinder pressure safety valves are not used, and as to uniformity of operation with older equipment, the 24-pound brake pipe reduction produces equalization (110 — 24 = 86), while 24-pound reduction opens the high-speed reducing valves on older equipment, giving maximum service braking power in both cases.

The difference in the two types of universal valves is entirely in the final or safety valve section of the emergency portion, and in the addition of the emergency or second brake cylinder. The portion in question is shown above or back of the gasket behind the emergency piston and slide valve; for the single cylinder this portion contains the intercepting valve, protection valve, high-pressure valve, cut-off valve and safety valve, and when two cylinders or the valve shown is used the parts mentioned are replaced by a portion containing a protection valve, an emergency valve, a service brake cylinder check valve and an emergency reservoir check valve.

The duty of this protection valve is the same in both equipments, the duty of the emergency valve is to admit emergency reservoir pressure to the emergency and service brake cylinders, the emergency reservoir check valve separates the emergency from the service reservoir during all operations except emergency and the service brake cylinder check valve separates the service and emergency cylinders during all operations except emergency.

All other parts of the universal valves are the same and referring to the magnet bracket portion, the principal parts are the service magnet and valve which control the electric application of the brake by making brake pipe reductions on each car, the release magnet and valve which control the electric release of brake cylinder air, the emergency magnet and valve which cause the emergency parts to operate by venting air from the emergency slide valve piston cylinder to the atmosphere, the emergency switch which closes the emergency magnet circuit at the same time the quick action valve is opened and the electric service port check valve which prevents a back flow of brake cylinder air to the brake pipe. There is also a magnet valve cut-out cap by means of which either or both of the service and emergency magnet valves may be cut out if it becomes necessary.

Before describing electric operation we would call attention to a brake valve of the electro-pneumatic type which will give a general idea of the electric portion used in steam road service. This brake valve is, however, an improvement upon the ordinary automatic brake valve in that it has a combination of direct and equalizing exhaust ports for service operation, a reduction limiting feature whereby the point of equalization cannot be passed in service operations, and a collapsible type of equalizing piston which prevents any overcharge of the brake valve reservoir or unequal pressures surrounding the equalizing discharge valve. This brake valve is the most efficient type for pneumatic operation as it eliminates all of the time element of brake valve operation and embodies a maximum pneumatic perfection before electric transmission becomes a necessity.

The electric portion can be added to the standard H6 brake valve by minor changes in the valve body, handle and rotary key, the drum above the pneumatic body contains the contact fingers, the upper one connected with the supply, the second with the release magnet line, the third with the application magnet line and the fourth with the emergency magnet line.

The handle and key operates both portions simultaneously, that is, the same position of the handle produces the same brake action either electric or pneumatic, or stated differently, the handle in service position pneumatic means electric service or pneumatic emergency position means electric emergency.

Electric control consists chiefly of a system of wiring on cars and locomotive and suitable jumper connections, and a source of supply or current which may be obtained at any one point on the train or locomotive. Voltage required is merely sufficient to energize a series of magnets.

On the universal valve bracket the magnets are attached to and operate air valves called magnet valves so that when a magnet or series of magnets are energized their armature is pulled down, which moves the magnet valves and in this manner the valves, by opening and closing suitable ports leading to the pneumatic portion, control the escape of brake pipe and brake cylinder pressure for service or emergency operation and release of the brake.

As stated the contact drum of the brake valve makes the necessary connections for current to energize the magnets and provides for a pneumatic blow-out of the arc existing immediately after disconnection or severing of contact.

Assuming the equipment to be charged up pneumatically as explained in last month's issue, a brake pipe reduction is necessary to operate the universal valve and electrically this is the duty of the service magnet. The duty of the emergency magnet is to operate the emergency portion of the universal valve and the release magnet and valve open and close the brake cylinder exhaust port at the will of the operator.

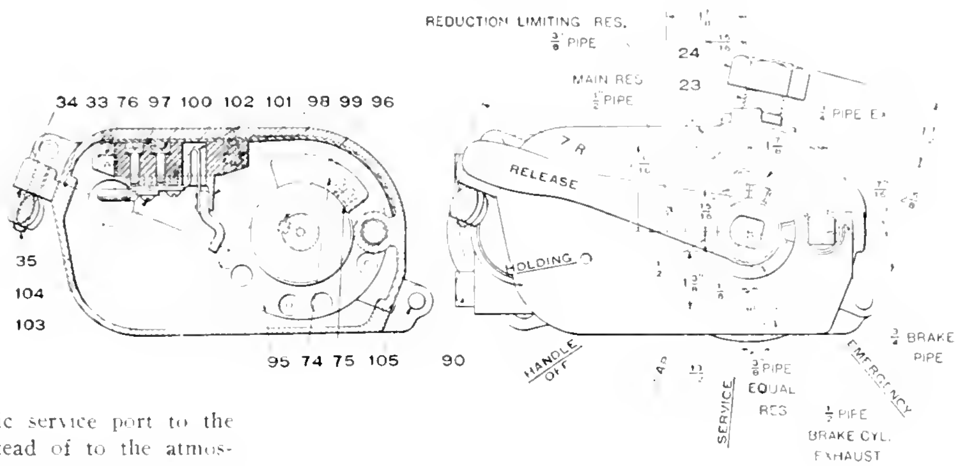
Normally all magnets are de-energized or with the handle of the brake valve in running position there is no current on except in the batteries, supply wires and connection to the emergency switch.

Normal positions of the magnet valves are, service and emergency magnet valves closed and release magnet valve open, hence in running position ports leading from service and emergency magnet valves to the equalizing and emergency pistons are closed and the brake cylinder exhaust port is open.

Service and emergency magnets are energized when those positions of the brake valve are used, but the release magnet is held energized in both release and holding positions.

When a service application of the brake is desired, the brake valve handle is moved to service application position and the service magnet circuit is closed and the service magnets are energized and the magnet valves unseated by the movement of the armature and a brake pipe reduction is made at each universal valve before the equalizing piston of the brake valve can lift or unseat to discharge brake pipe pressure.

This reduction takes place from the equalizing piston cylinder of the universal valve through port P 1, past the service magnet valve, thence to the atmosphere, or if the atmospheric opening has been plugged and the plug removed from the service port, brake pipe pressure will flow



through the electric service port to the brake cylinder instead of to the atmosphere.

The amount of brake pipe reduction made, consequently the amount of brake cylinder pressure obtained, depends upon the time the valve handle remains in service position, a full service reduction will be made by holding the handle in service position which holds the service magnet circuit closed or any number of light reductions are made by moving the handle back from service position which severs electric contact with the service magnets and the prompt pneumatic blow-out of the arc causes the magnets to instantly de-energize and suitable springs promptly close the magnet valves cutting off the brake pipe reduction. The movements of the universal valves to lap position have been explained in connection with pneumatic operation.

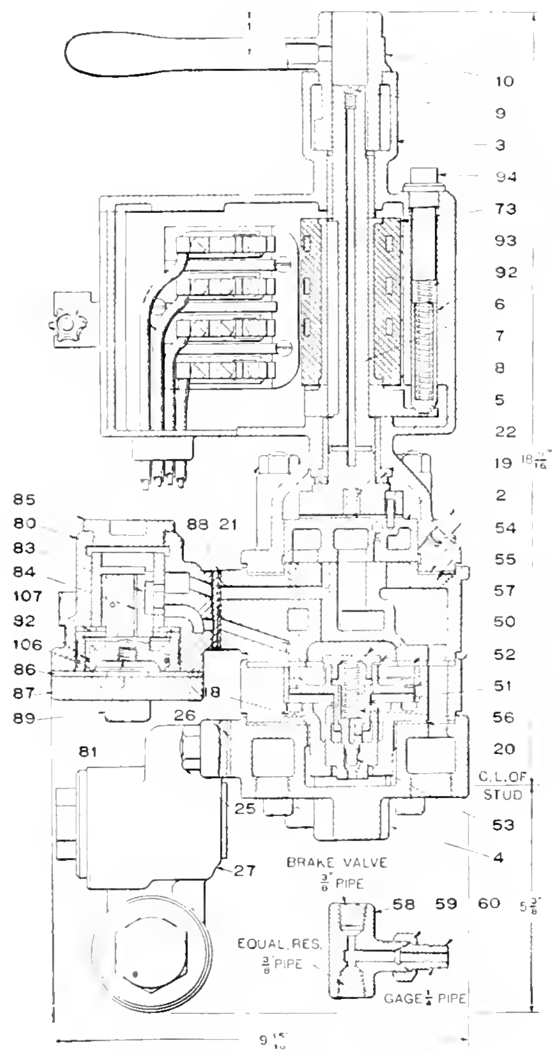
If the electric brake pipe reduction permits brake pipe pressure to flow through the electric service port check valve to the brake cylinder, as shown in the diagram, obviously these two pressures are approaching each other as the reduction continues and as they near equalization the rate of brake pipe reduction is gradually decreasing to zero, hence in order to procure the desired pressure in the given time, the rate of reduction is at the beginning quite rapid and the margin between service and emergency rate is very small, but still, not sufficient to exceed the capacity of the emergency piston feed groove to expand quick action chamber pressure without producing quick action, however, this margin is broadened as the reduction continues and brake cylinder pressure increases.

However, if a uniform margin between service and emergency rates of reduction are desired, the service magnet valve connection to the brake cylinder may be closed with a pipe plug and the connection to the atmosphere opened and then the reduction from the brake pipe pressure is limited to the point of equalization by the reduction limiting check valve located in the equalizing piston of the universal valve.

A glance at the diagrammatic view will show that when the equalizing portion passes full service position, due to brake pipe pressure passing the point of equalization, auxiliary reservoir pressure will force the piston against the cylinder cap gasket, thereby closing the port leading to the service magnet valve and prevent an over-reduction of brake pipe pressure.

Trusting that this has made clear the manner in which any desired degree of service application is made, the movements of the universal value to lap position being the same as mentioned in connection with pneumatic operation, a release is accomplished by moving the brake valve handle to release or holding position, depending upon the length of the train then to running position.

In release and holding positions the release magnets are energized holding the release magnet valves closed to prevent the escape of brake cylinder pressure while the increase in brake pipe pressure returns the operating parts of the universal valves to release and charging position, then as the release of brake cylinder

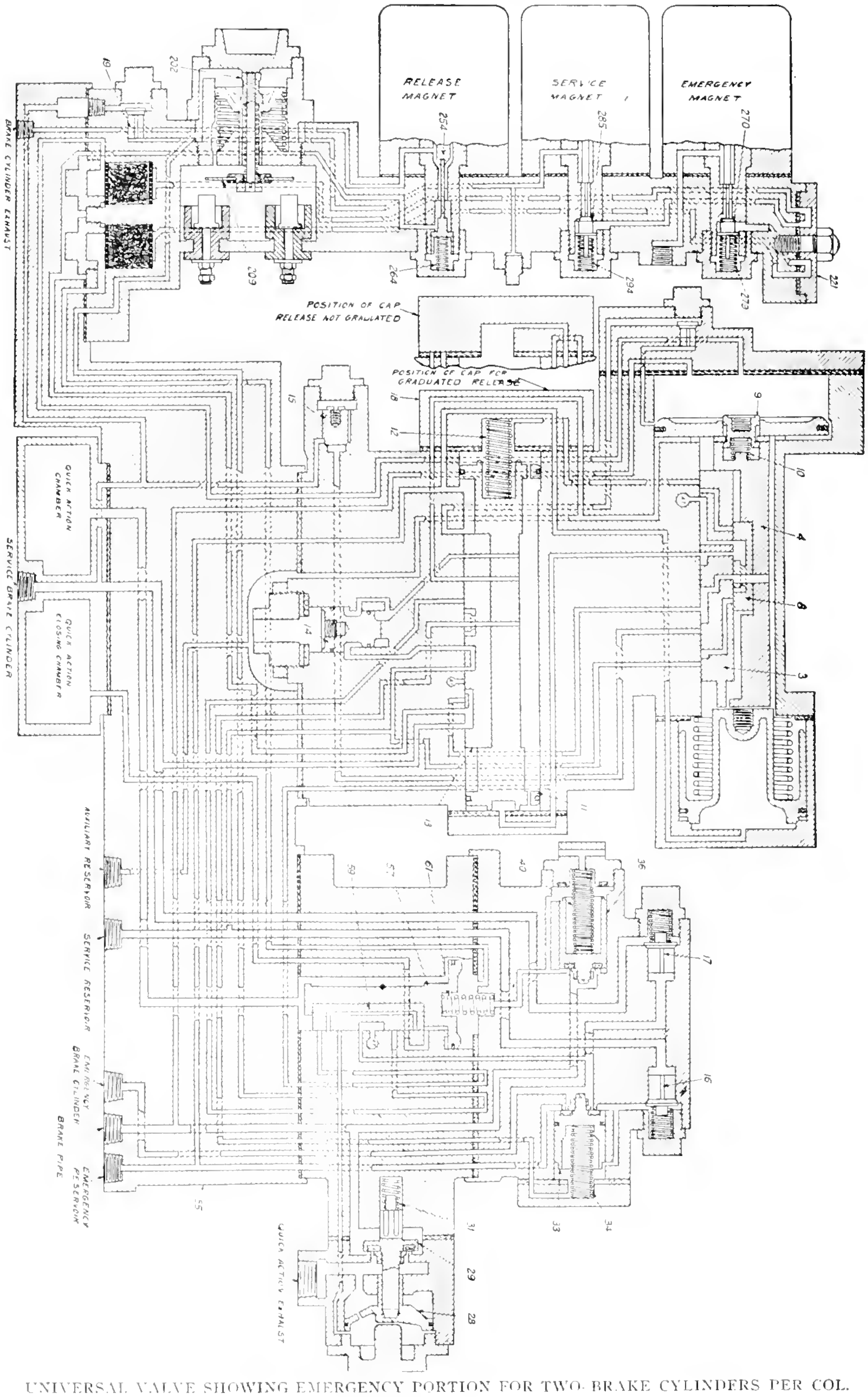


ELECTRIC PNEUMATIC BRAKE VALVE.

pressure is desired the valve handle is moved to running position which de-energizes the release magnets and the springs instantly, open the magnet valves, permitting the escape of brake cylinder pressure for the release of brakes.

It may here simplify the explanation of release position to state that regardless as to whether the release piston cylinder covers are in direct or graduated release position the energizing and de-energizing of the release magnets provides a perfect graduation of release as the release magnet valves alone control the escape of brake cylinder pressure, alternating the brake valve handle between running and holding positions in connection with the pneumatic blow out of the arc, gives an instantaneous exhaust or retention of brake cylinder pressure at will.

When an emergency application of the brake is desired the valve handle is quickly moved to emergency position in the usual manner. This closes the emergency magnet circuit and instantly energizes the emergency magnets whereupon the armatures knock the magnet valves from their seats and exhaust air pressure from the emergency piston chamber to the atmosphere at a faster rate than quick



UNIVERSAL VALVE SHOWING EMERGENCY PORTION FOR TWO BRAKE CYLINDERS PER COL.

action chamber pressure can expand through the emergency piston feed groove, consequently the emergency piston and slide valve move to emergency position with the same result outlined in pneumatic emergency operation.

While the direct exhaust port of the brake valve is also open, the electric current travels so much faster than any possible reduction of air pressure, that it is electric emergency that controls and applies all the brakes in the train and is instantaneous in action. Now another glance at the diagram will show a port leading from the quick action piston port to the emergency switch piston in the magnet bracket. This emergency switch is the connecting link between electric and pneumatic emergency so that if a conductors valve is opened in any portion of the train the first universal valve going into pneumatic emergency will move the emergency switch piston at the same time the quick action piston is moved and the closing of the emergency switch instantly transmits electric emergency throughout the train as these switches close the emergency magnet line and energize the emergency magnets in the same identical manner that the contact in the brake valve produces electric emergency.

In the event of a break in two of train, electric emergency would thus prevail upon the head end of the train due to current still being applied, and pneumatic emergency would occur on the rear end on account of current being cut off by separation.

The release of brakes after an electric emergency application is the same as a release after pneumatic emergency and we believe the above description of electric operation will be satisfactory for the time being, the entire control system being remarkable for its simplicity, and as previously stated, universal valves operate in perfect harmony with triple and control valves and the electric and pneumatic operation is identical, or operatively interlocked so that any failure of the electric portion cannot affect the pneumatic operation.

As to current, battery current is fundamentally desirable because of its reliability, uniformity and availability. It is immaterial how the battery is charged, provided that it is of ample capacity.

The wiring scheme should be such that the fact that current is obtainable at the brake valve insures that all jumpers are in place throughout the train, as an interrupted control current is in a degree analogous electrically to a closed angle cock in pneumatic operation.

In steam road service, with means of obtaining current from car lighting systems, a device must be provided to prevent inadvertently cutting the brake supply wires into more than one source of electrical energy at the same time.

The fundamental principles relative to electric control of the automatic brake are:

1. The electric control system is not, either in its proper or improper action, or in its failure to act in any manner, impairing the stopping power of the automatic system.

2. During electrical control of brake applications, loss of current can not cause any loss of braking power already obtained.

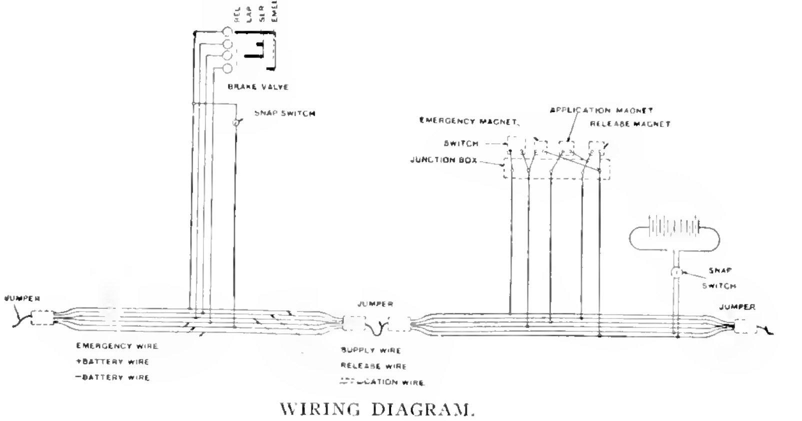
3. The opening of the application magnet valves is invariably accompanied by the closing of any possible outlet to the atmosphere.

4. The application and exhaust magnets of the electric brake are cut off from connection with the atmosphere when the brake is automatically applied.

5. The design of the brake is such that it purposely actuates the universal valve as with an automatic application, and a brake pipe reduction approximately equal to that required for a pneumatic application is made; which is to say, the operation of the electro-pneumatic brake is as nearly as possible the equivalent in all particulars of the operation of the pneumatic brake.

6. The best electro-pneumatic system is that which uses the same positions of the brake valve as the pneumatic and operates the brake in the same way.

7. The electro-pneumatic quick action emergency is essential to the safety of modern trains and traffic; therefore, such a reserve of compressed air must be reserved as will permit of an emergency application at any time.



WIRING DIAGRAM.

Now it will be understood that only the operation of the brake is electrically controlled and that compressed air serves as the medium of power transmission or that the application of electricity adds no braking power beyond that secured by instantaneous action, and there are three objects in adding electric control, namely, increased safety (emergency), reduction in time required to make stops (service), and instantaneous and simultaneous response and uniform application whereby the human equation relating to manipulation is reduced to a minimum.

It will also be understood that this brake system is highly developed pneumatically before electric control is considered and the Westinghouse Air Brake Co. does not recommend electric control for all manner of air brake systems, in fact, they take the stand that electric control cannot become a necessity until after the pneumatic brake is brought to its highest possible state of perfection. However, once the limit of pneumatic perfection is exceeded by unusually severe requirements the electric control may be added and it is seldom that any one device offers the solution of so many air brake problems as it not only eliminates the time element so far as brake initiation and propogation is concerned but it eliminates retardation shocks since it reduces brake operation to the problem or effect of stopping a train as a single car.

It is so promptly responsive and flexible that correction of errors in judgment during manipulation can be made before inconvenience or damage can occur. While the safety features have been mentioned, it is especially valuable from a revenue standpoint as it permits of stops being made in much less time with a reliability, smoothness, and accuracy heretofore impossible.

A Business Compass.

This is the title of a booklet just off the press which describes methods of tabulating and analyzing statistics of all sorts—manufacturing, sales, insurance, transportation, etc. The method depends upon the use of punched cards with a properly arranged code system adapted to each individual business. The various columns on the cards may be made to represent anything and to analyze anything, from the cost of building a tool or other product of a certain type and size, or to locate the date on which a certain man at some period long past was working on a certain machine, or any other purpose for which it might conceivably be used. The system has been perfected for general use and has been adopted by hundreds of concerns all over the country. Copies of the booklet may be obtained from the Tabulating Machine Co., 25 Broad street, New York.

Electrical Department

Electric Locomotives for the Connecticut Company.

An example of the advantages to be obtained from the use of electric locomotives is that of the above. Two locomotives of the Baldwin-Westinghouse are used to haul freight about 1½ miles from the nearest railroad track up grade, with a maximum of 5 per cent., to the plant of the Chase Rolling Mill Company, Waterbury, Conn. Heretofore all the hauling, raw material and finished product, to and from the station, has been handled by eight-horse teams, which proved to be expensive.

The locomotives make from 8 to 10 trips per day, and with a load of approximately from 100 to 125 tons each. This load is governed by the 5 per cent. grade, which is 3,000 feet in length. These locomotives have been in operation from the beginning of last year and have had a perfect record.

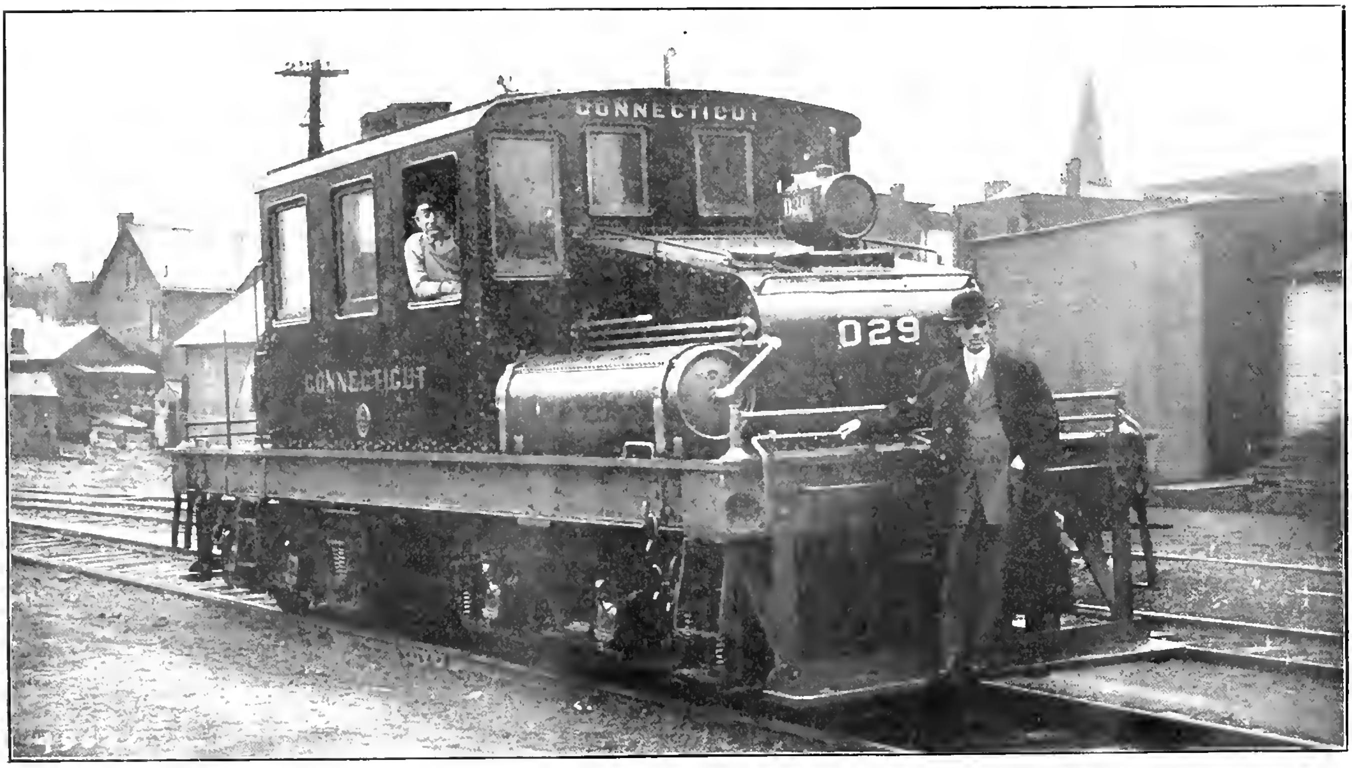
An arrangement which is productive of good results is that the same engineer has the same locomotive and maintains same, *i.e.*, makes any inspection necessary.

Following are the general dimensions:

MECHANICAL DATA.

Truck wheel base	4 ft. 6 ins.
Total wheel base	20 ft. 0 ins.
Length over bumpers	28 ft. 9 ins.
Length of cab inside	12 ft. 0 ins.
Length of hoods	6 ft. 6 ins.
Width of hoods	4 ft. 6 ins.
Width over all	8 ft. 6 ins.
Diameter of driving wheel	34 ins.
Total height over cab roof	11 ft. 0 ins.
Gauge	4 ft. 8½ ins.
Trucks	2-4 wheel swiveled
Weight	45 tons

The electric locomotive is well adapted for this class of work, for it is easy to choose one of the proper weight to give the necessary tractive effort and adhesion, for the class of work to be handled. Moreover, all of the weight is on drivers, each axle having an electric motor geared to it. The physical conditions in this application, i. e., the 5 per cent. grade for 3,000 feet, would be a serious handicap for the steam locomotive, for it would be necessary to use one very much larger to handle the load over the grade than would ordinarily be required. It is possible with the electric locomotive to obtain for short periods tractive efforts much greater than the rating, which is not true with the steam locomotive, for the maximum depends on the boiler pressure. This inherent characteristic is of great value for a comparatively small locomotive, as above, of only 45 tons, can handle 125 tons up the 5 per cent. grade. This advantage should be more generally known and realized, for there are hundreds of factory shops, etc., which could show a saving by doing the switching and freight work from the main line railroad by electric locomotives.



ONE OF TWO 45 TON ELECTRIC LOCOMOTIVES FOR THE CONNECTICUT COMPANY.

Ozone Machines.

During the past year the ozone machines or ozonizers, as they are called, have been placed before the public with prominent statements made as to the great benefits to be derived from their use, due to the purification of the air. These ozone machines were recommended for schools, waiting rooms and other public places.

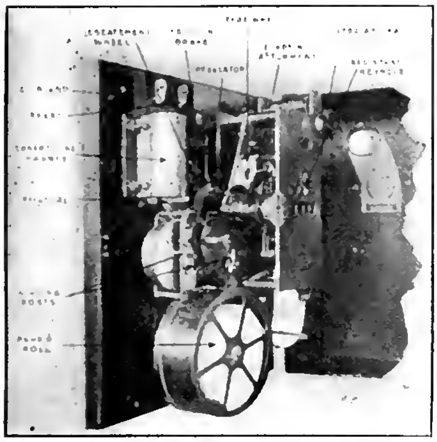
Recently Dr. W. A. Sawyer, director of the Hygienic Laboratory of the California State Board of Health, made a series of tests as to the effect of ozone generated by these machines on bacteria and on public health.

It was found that one part of ozone in every million irritates the mucous membranes of the human body, and in greater quantities will cause serious results. Typhoid or similar germs required the ozone gas in large quantities to kill them, and these germs were destroyed

only after guinea pigs, which were exposed to the same gas, had died.

The machines produce gases which mask disagreeable odors of moderate strengths, without removing the bad effects thereof.

These tests show that the benefit derived from these machines is not as great as at first supposed. In fact, care should be used not to place these machines in public places, where the amount of gas may reach too large a percentage.



THE RICO COASTING TIME RECORDER.

Rico Coasting Time Recorder.

The Rico Coasting Time Recorder is an instrument that records the actual number of minutes that an electric car, train or locomotive is operated without the use of power or brakes. It is an efficient and desirable device to secure greater economy in operating railway equipments.

It reads in "coasting minutes" delivering a printed voucher-slip to the motorman or engineer at the end of the run. This voucher-slip shows, the degree of economy which he has exercised on every run. By a system of ranking or rewards the railroad company induces the men to economical operation and thus greatly reduces the amount of current used.

The greater the amount of coast the greater the saving in power. The energy input to a train, or car, is utilized to overcome the resistor losses in starting, to overcome losses in the motors and the wiring, to overcome friction losses, to impart velocity to the car and in the brakes. The losses thrown away in the brakes is enormous, and this is where the saving can be accomplished. The energy stored up in a train and which must be dissipated in the brakes is in proportion to the square of the speed at the time of braking. That is, a train at 20 miles per hour has four times as much energy as one running at 10 miles per hour. Thus it is very easy to throw away power in the brakes by applying the brakes at a high speed when the same schedule could have been maintained by shutting off power sooner, coasting and applying brakes at a lower speed. Economy of current consumption can be effected by the nearest permissible approach to coasting to a standstill, which, of course, is not practicable. However, as much coast as is possible should be obtained, and this is the object of installing the Rico Coasting Clocks.

The Coasting Recorder is a simple and reliable automatic device which effectively puts an automatic and impartial check upon each man. It is a guide to him to operate properly. The circuits are so arranged that the recording clock cannot register when power is on, when brakes are applied or when the train has stopped, so that it is impossible to obtain a fictitious record.

The coasting clocks are used extensively in the New York subways and have demonstrated their advantages.

Storage Battery Industrial and Mining Locomotives.

Many improvements in the design of storage batteries have recently been effected, so that they are now being successfully used for propelling, not only commercial vehicles, but also small locomotives running on narrow gauge railways. Until a few years ago it would have been impractical to consider the use of batteries for propelling locomotives on rails, due to their mechanical strength and the short life.

Storage battery locomotives will be found economical and useful in such places as factory yards, where it is undesirable to string the regular trolley wires; inside of factory buildings, where it is desired to carry material from one floor to another; in foundries, where heavy castings may be placed on the car platform and transported to any desired distance quickly and economically; in mines for gathering work and hauling; for tunnel work, where head room does not permit trolley wires to be installed; about powder mills to minimize the fire hazard; about lumber yards.

Local conditions will determine whether or not the battery locomotive is desirable. This type of locomotive possesses all the well-known advantages appertaining to the ordinary electric locomotive, as compared to steam and animal haulage, among which are the following:

It consumes power only when in actual operation.

It can be operated by any man of ordinary intelligence.

It is ready for use at all times during the day, providing it has been given its full charge during the preceding night or idle period.

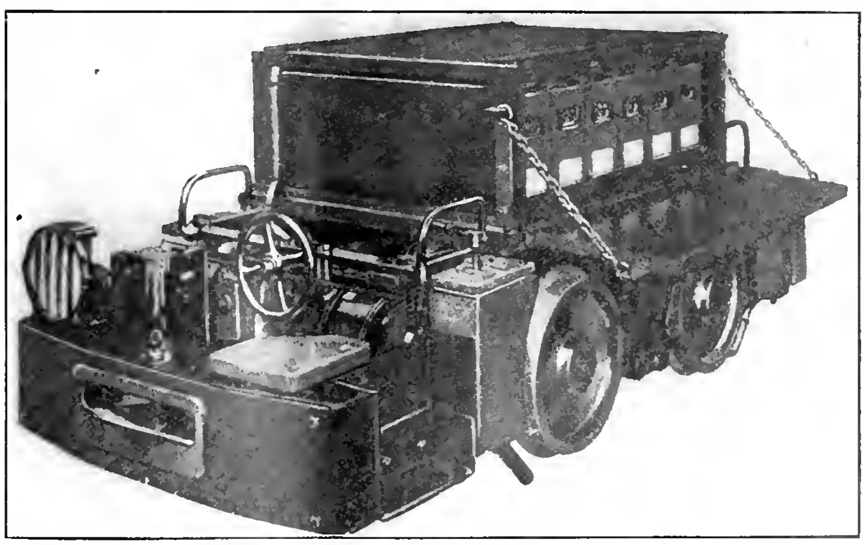
It has a large momentary overload capacity.

It possesses an easy and perfect system of control.

It can be run inside of buildings and in other localities where smoke and fire is a risk.

The mechanical and electrical parts are few and simple, resulting in low maintenance cost.

A large variety of these battery locomotives are built by the General Electric Company, for gauges from 18 ins. to 56½ ins., and in sizes from 2½ to 7 tons. There are two forms: one of the platform type used for carrying the load directly on the platform, and is adaptable for carrying patterns, casting, etc.; the other of the haulage type. A view of the latter type is shown herewith, and the batteries are shown in place.



HAULAGE TYPE OF STORAGE BATTERY LOCOMOTIVE, SHOWING ARRANGEMENT OF BATTERY.

The Central Railway and Engineering Club.

The regular monthly meeting of the Central Railway and Engineering Club of Canada was held in Toronto on December 23. A paper was read on "Scientific Illumination," illustrated by lantern views, by Mr. J. W. Helps. Mr. C. L. Worth, Toronto, is secretary.

Pacific and Mikado Locomotives for the Southern Railway

The Southern Railway has recently placed in service 25 locomotives which were built by The Baldwin Locomotive Works. Ten of these are of the Pacific type for heavy passenger service, and fifteen of the Mikado type for freight service. These types are now standard for heavy traffic on the Southern Railway System. This company has maintained a conservative policy regarding its motive power, basing new designs, as far as possible, on locomotives which have proved successful, while introducing improvements in detail to enable the new engines to better meet the requirements of the service. This is well illustrated in the case of the Pacific type locomotives, which represent the latest development of a design originally built for the Southern by The Baldwin Locomotive Works in 1903. The first engines used saturated steam, and were equipped with slide valves and Stephenson link motion. In a subsequent design, Walschaerts gear was adopted while the slide valves were retained. Finally, in 1912, superheaters and piston valves were applied, this change being accompanied by an increase in cylinder diameter and a reduction in steam pressure. The total number of Pacific type locomotives thus far built by The Baldwin Locomotive Works for the Southern and its affiliated lines is 116, and a marked similarity is evident in all these engines, although the dates of their introduction extend over a ten-year period.

The new superheater Pacifics exert a tractive force of 35,000 pounds, and with 140,700 pounds on driving wheels the ratio of adhesion is 4.03. The weight is thus utilized to the best possible advantage, while with reasonably careful handling the full tractive force can be developed under all ordinary service conditions. The use of a relatively low ratio of adhesion is quite in keeping with accepted practice for superheater locomotives. With large cylinders, high horsepowers can be developed when working at comparatively short cut-offs. This can be done, in a superheater locomotive, without trouble due to cylinder condensation; and the result is a marked improvement in efficiency.

The details of these locomotives are designed in accordance with the railway company's practice. The frames are vanadium steel castings, strongly braced transversely. The trailing truck is of the Rushton type, with inside journals; a design that has been applied to all the Pacific type locomotives built for the Southern. The cylinders and steam chests are lined with bushings of Hunt-Spiller metal, and the same material is used for the valve and piston packing rings. The tender frame is composed of 12-inch 40-pound channels, with white-oak bumpers. The tender trucks are of the arch-bar type, with solid rolled steel wheels.

The Mikado type locomotive illustrated is one of 145 which have been placed in service during the past two years on the Southern Railway, the Queen and Crescent Route, the Mobile & Ohio R. R., and the Virginia & Southwestern Railway. These engines are all built to the same design, and have done excellent work, handling increased tonnage as compared with the Consolidation type locomotives formerly used, with important reductions in water and fuel consumed per ton mile, as shown by carefully conducted tests. The tractive force developed by the Mikados is 51,700 pounds, and they are specially adapted to heavy work, while at the same time, with 63-inch wheels, they can be used in fast freight service, or even for handling passenger trains, should special conditions so require.

The tables give further particulars of these two types of locomotives.

PACIFIC TYPE LOCOMOTIVE.

Gauge, 4 ft. 8½ ins.; cylinders, 24 by 28 ins.; valves, piston, 12 ins. diameter.

Boiler—Type, straight; diameter, 70 ins.; thickness of sheets, ¾ and 13/16 in.; working pressure, 185 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 108⅛ ins.; width, 72¼ ins.; depth, front, 76¼ ins.; depth, back, 68¾ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water space—Front, 4½ ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Diameter, 5½ and 2¼ ins.; material, 5½ ins., steel; 2¼ ins., iron; thickness, 5½ ins., No. 9 W. G.; 2¼ ins., No. 11 W. G.; number, 5½ ins., 28; 2¼ ins., 176; length, 20 ft.

Heating Surface—Firebox, 192 sq. ft.; tubes, 2,866 sq. ft.; total, 3,058 sq. ft.; grate area, 54 sq. ft.

Driving Wheels—Diameter, outside, 72½ ins.; diameter, center, 66 ins.; journals, main, 10 by 12 ins.; journals, others, 9 by 12 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 5½ by 10 ins.; diameter, back, 42 ins.; journals, 8 by 12 ins.

Wheel Base—Driving, 12 ft. 6 ins.; rigid, 12 ft. 6 ins.; total engine, 31 ft. 4½ ins.; total engine and tender, 67 ft. ½ in.

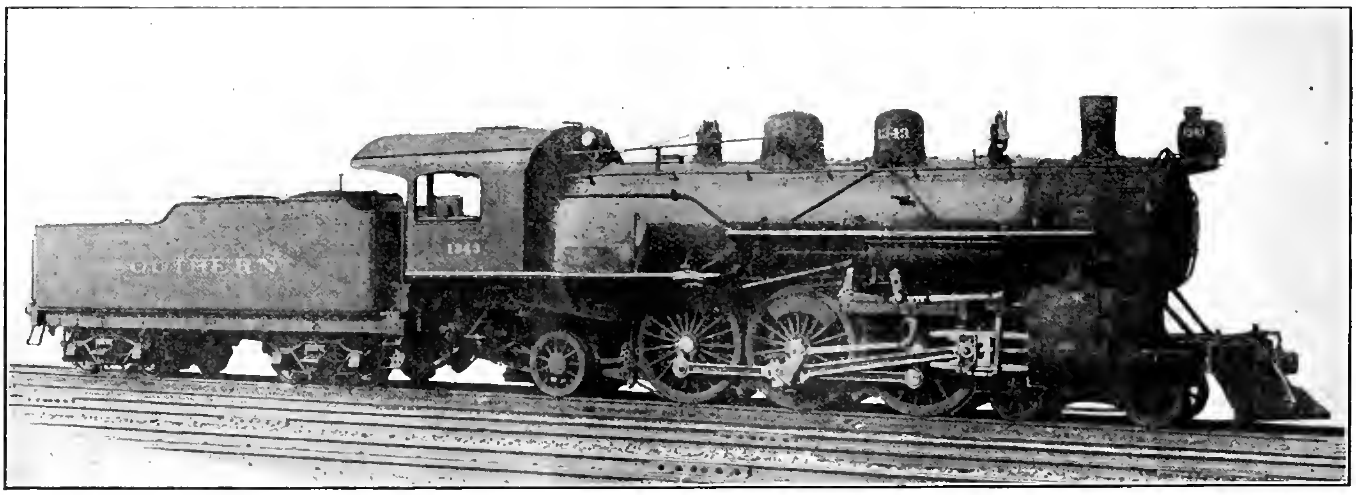
Weight—On driving wheeds, 140,700 lbs.; on truck, front, 48,300 lbs.; on truck, back, 42,300 lbs.; total engine, 231,300 lbs.; total engine and tender, about 375,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ by 10 ins.; tank capacity, 7,500 gals.; fuel capacity, 12 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 660 sq. ft.

MIKADO TYPE LOCOMOTIVE.

Gauge, 4 ft. 8½ ins.; cylinders, 27 by 30 ins.; valves, piston, 14 ins. diameter.



PACIFIC TYPE, 4—6—2 LOCOMOTIVES FOR THE SOUTHERN RAILWAY.

A. Stewart, Gen. Supt. Motive Power and Engines. Baldwin Locomotive Works, Builders.

Boiler—Type, wagon-top; diameter, 76 ins.; thickness of sheets, 3/4 and 13/16 in.; working pressure, 175 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 107 1/8 ins.; width, 71 3/4 ins.; depth, front, 78 ins.; depth, back, 62 ins.; thickness of sheets, sides, 3/8 in.; thickness of sheets, back, 3/8 in.; thickness of sheets, crown, 3/8 in.; thickness of sheets, tube, 1/2 in.

Water Space—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes—Diameter, 5 1/2 and 2 1/4 ins.; material, 5 1/2 ins., steel; 2 1/4 ins., iron; thickness, 5 1/2 ins., No. 9 W. G.; 2 1/4 ins., No. 11 W. G.; number, 5 1/2 ins., 30; 2 1/4 ins., 183; length, 20 ft.

Heating Surface—Firebox, 191 sq. ft.; tubes, 3,007 sq. ft.; total, 3,198 sq. ft.; grate area, 53.3 sq. ft.

Driving Wheels—Diameter, outside, 63 ins.; diameter, center, 56 ins.; journals, 10 by 12 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 6 by 12 ins.; diameter, back, 42 ins.; journals, 8 by 14 ins.

Wheel Base—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total engine, 34 ft. 9 ins.; total engine and tender, 67 ft. 1/2 in.

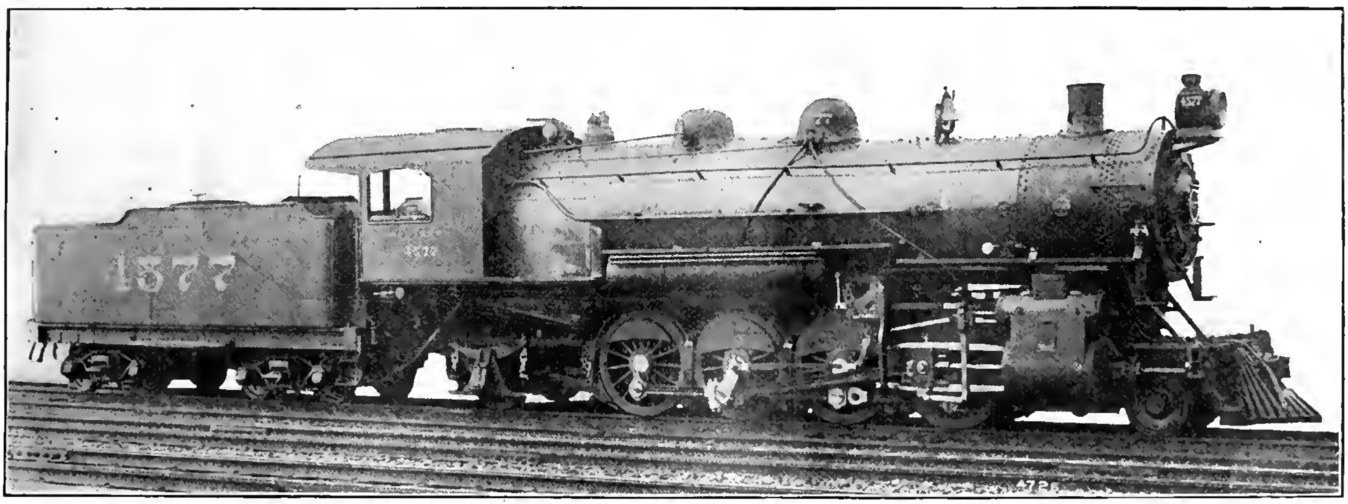
Weight—On driving wheeds, 215,600 lbs.; on truck, front, 23,400 lbs.; on truck, back, 35,400 lbs.; total engine, 274,400 lbs.; total engine and tender, about 422,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5 1/2 by 10 ins.; tank capacity, 8,000 gals.; fuel, 12 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 699 sq. ft.

Steel Passenger Coaches.

Steel coaches have so many advantages over wooden ones that though their advent into the railway world has been somewhat slow it may be taken as certain that they will eventually become universal. It has long been debated whether a steel underframe with a wooden body is good engineering practice. Its chief defect is a difficulty in securing the two parts together so well as to prevent the body from beginning to work as the car becomes old; nor is there much advantage in either weight or cost in such a combination over a car of all steel construction. The present taste points to a timber lining inside as being more ornamental and better for insulation. In Western countries the main problem is to keep the temperature inside from falling too low while in the East it is to keep it from getting too high; and a wooden lining serves equally one way as the other. But there are objections to wood on the score of destructibility in an accident, either by collapse or by fire; and it is quite possible that in time railways will largely adopt even an interior steel finish. Such all-steel cars as have been built usually have a metal floor covered with a flexible cement. Trial has recently been made with one in which the floor had in addition half an inch of cork while the sides were insulated by means of two inches of cork fixed against the outside plating. The trials showed that this car was warmer inside than the ordinary wooden car during winter and it would presumably be cooler inside in the summer. The temperature of water placed in cans on the floor was practically the same in this and the wooden cars. Insulation difficulties have therefore been surmounted. But there are also other methods of insulation. One is to fill the space between the sheathing and lining with block magnesia and magnesia cement; another to provide a fairly wide air space and protect both sheathing and lining with several coats of paint. Careful provision for ventilation which secures that the air in the car is continually renewed, that there is a window surface of about one-third of the area of the side walls, and double instead of single windows, all serve in addition to keep the car warm in the winter and cool in the summer. Such cars when tested against wooden cars by being kept standing on a siding exposed to the sun in hot weather with doors and windows closed, were found to record an inside temperature one or two degrees higher. Some further objections to a wooden lining with a steel sheathing are that it adds to the weight of the car without adding to its strength, that it is difficult to make provision for expansion and contraction with it since the car itself may sometimes expand and contract to the extent of half an inch, and that while timber is constantly rising in price steel is daily growing cheaper. A steel car built with framing, sheathing and lining all in one is a much stronger structure than either a wooden or a composite car, and this is a great consideration at the present day when speeds are high and the results of accidents disastrous. The aim of designers is to secure that car ends are so strong as to withstand a collision without telescoping and that sides and roof are strong enough to resist collapse if a car should turn over and roll down an embankment; and these requirements can be met by all-steel cars only. Their cost at first will probably be 20 per cent. per passenger higher than wooden cars, but this will soon be made up by reduced maintenance. Moreover, it is possible that in a very few years even their first cost will be no higher because the value of timber is rising so rapidly. As matters are pointing just now it therefore seems extremely probable that all-steel cars will one day become universal, particularly as their behavior in accident is constantly proving their superiority. As an example, there is the recent case of the failure of an embankment on the New York Central and Hudson River Railway, when eight cars of an express were hurled into the river. Only six passengers were injured, none seriously; and the damage to the stock was relatively insignificant. It is believed that with wooden cars the effects on both stock and passengers would have been extremely serious.



MIKADO TYPE, 2—8—2 TYPE LOCOMOTIVE FOR THE SOUTHERN RAILWAY.

Items of Personal Interest

Mr. J. E. Steward has been appointed signal engineer of the Vandalia, with office at Pittsburgh, Pa.

Mr. C. L. Sykes has been appointed master mechanic of the Orangeburg, with office at Orangeburg, S. C.

Mr. F. B. Smith has been appointed supervisor of signals of the Pennsylvania, with office at Sunbury, Pa.

Mr. J. W. Baum has been appointed general foreman of the Pennsylvania Southern, with office at Clarion, Pa.

Mr. H. H. Parker has been appointed master mechanic of the Seaboard Air Line, with office at Jacksonville, Fla.

Mr. J. A. Cassady has been appointed master mechanic of the Alabama Great Southern, with office at Birmingham, Ala.

Mr. Fred C. Simpson has been appointed general foreman of the Southern at Asheville, N. C., succeeding Mr. E. L. Adams.

Mr. J. A. Barker has been appointed road foreman of engines of the Chesapeake & Ohio of Indiana, with office at Peru, Ind.

Mr. B. Powers has been appointed road foreman of engines of the Detroit, Toledo & Ironton, with office at Springfield, Ohio.

Mr. J. V. B. Duer has been appointed assistant engineer of the Pennsylvania at Altoona, Pa., succeeding Mr. B. F Wood, resigned.

Mr. William W. Wicks has been appointed road foreman of engines of the Northern Pacific, with headquarters at Jamestown, N. D.

Mr. M. A. Hall has been appointed superintendent of shops of the Kansas City Southern at Pittsburg, Kan., succeeding Mr. C. W. Bugbee.

Mr. William Ewald has been appointed superintendent of motive power of the Cumberland & Pennsylvania, with office at Mt. Savage, Md.

Mr. Harold B. Hayes has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific, with office at Somerset, Ky.

Mr. R. C. Wallace has been appointed general foreman on the Baltimore & Ohio Southwestern, at Cincinnati, Ohio, succeeding Mr. A. E. McMillan.

Mr. J. S. Kuhns has been appointed general foreman of the Atchison, Topeka & Santa Fe, with office at Clovis, N. M., succeeding Mr. Thomas Booth.

Mr. B. E. Roosa has been appointed general foreman motive power department of the Delaware, Lackawanna & Western, with office at Syracuse, N. Y.

Mr. P. O. Wood has been appointed assistant superintendent of locomotive performance of the St. Louis & San Francisco, with headquarters at Springfield, Mo.

Mr. F. E. Bates, formerly assistant engineer of the Chicago, Milwaukee & St. Paul, has been appointed chief draftsman of the bridge department of the Missouri Pacific.

Mr. J. M. Gailey has been appointed acting master mechanic of the San Pedro, Los Angeles & Salt Lake, with office at Milford, Utah, succeeding Mr. J. R. Greiner.

Mr. R. Collett, formerly superintendent of locomotive fuel service on the St. Louis & San Francisco Railroad, has the title changed to superintendent of locomotive performance.

Mr. J. Sheppard has been appointed district master mechanic of the Ontario division of the Canadian Pacific, with office at West Toronto., Ont., succeeding Mr. W. J. Pickerel.

Mr. Charles Manley has been appointed superintendent of motive power of the Tehuantepec National, with office at Rinton Antonio, Oax., Mexico, succeeding Mr. H. P. Durham.

Mr. H. C. Dyke has been appointed general foreman of the Cincinnati, New Orleans & Texas Pacific, with office at Danville, Ky., and Mr. W. B. Bunn has been appointed to a similar position on the same road, with office at Chattanooga, Tenn.

Mr. J. W. Sasser, formerly master mechanic of the Seaboard Air Line, at Jacksonville, Fla., has been appointed superintendent of motive power of the Norfolk Southern, with offices at Norfolk, Va.

Mr. C. F. Stoltz has been appointed signal engineer of the Cleveland, Cincinnati, Chicago & St. Louis, Peoria & Eastern, with headquarters at Cincinnati, succeeding Mr. L. S. Rose, who has been assigned to other duties.

Mr Robert F. Byers, formerly shop foreman of the National Railways of Mexico, at Aguascalientes, Mex., has been appointed master mechanic of the Central Dominican Railway, with headquarters at Porto Plata, Dominican Republic.

Mr. A. G. Machesney, for 15 years traveling engineer and locomotive inspector of the Baldwin Locomotive Works, Philadelphia, Pa., has resigned to accept a position in the railway department of the Detroit Lubricator Company, Detroit, Mich.

Mr. Elliott Sumner, formerly master mechanic of the Pennsylvania, at Sunbury, Pa., has been transferred to Philadelphia, succeeding Mr. J. M. Henry, and Mr. Paul L. Grove has been appointed master mechanic at Sunbury, succeeding Mr. Sumner.

Mr. G. Clinton Gardner, Jr., formerly general foreman of motive power of the Manhattan division of the Pennsylvania at New York, has been appointed assistant engineer of motive power on the Northern division, with headquarters at Buffalo, N. Y.

Mr. W. H. Ripley has been appointed general foreman of the Lake Shore & Michigan Southern, with office at Englewood, Chicago. Mr. Ripley succeeds Mr. Alfred Herbster, who has been appointed traveling car foreman of the same road, with office at Cleveland, Ohio.

Mr. K. G. Chapman has been appointed road foreman of engines of the Northern Pacific, with office at Lester, Wash., succeeding Mr. W. W. Crosby, and Mr. L. L. Moebeck has been appointed to a similar position on the same road, with office at East Grand Forks, Minn.

Mr. W. P. Fitzgerald has been appointed master mechanic of the Chicago, Rock Island & Pacific, with office at Estherville, Ia., succeeding Mr. J. C. Rhodes, and Mr. William Germer has been appointed road foreman of equipment on the same road, with office at Chicago, Ill.

Mr. H. K. Lowry, formerly assistant signal engineer on the Chicago, Rock Island & Pacific, has been appointed principal assistant signal engineer, with office at Chicago, Ill. Mr. Lowry is a graduate of the Massachusetts Institute of Technology, and has had extensive experience on the principal Western roads.

Mr. W. G. Hall has been appointed division master mechanic on the International and Great Northern, with headquarters at Mart, Tex., and Mr. C. C. Shaw has been appointed general road foreman of engines. Mr. Shaw was formerly employed with the Pierce Fordice Oil Company as lubricating expert.

Mr. F. W. Ramer has been appointed locomotive foreman of the Great Northern, with office at Havre, Mont. Mr. Nicholas Hahn has been appointed to a similar position on the same road, with office at Glasgow, Mont., and Mr. J. D. Brown has been appointed to a similar position on the same road, with office at Billings, Mont.

Mr. W. H. Williams has been appointed storekeeper of the Baltimore &

Ohio, with headquarters at Ivorydale, Cincinnati, Ohio, succeeding Mr. F. A Murphy, who has been appointed traveling storekeeper, with headquarters at Baltimore, Md., and Mr. J. R. Orndorff has been appointed assistant storekeeper at the Mount Clare shops, Baltimore. Md

Mr. H. L. Kilian, formerly assistant signal supervisor on the Lake Shore & Michigan Southern, has been appointed supervisor of signals, with office at Toledo, Ohio. He succeeds G. E. Beck, promoted to chief signal inspector. Mr. K. F. Wakeman has been appointed assistant supervisor of signals at Toledo, and Mr. James Anderson has been appointel signal inspector at Cleveland, succeeding Mr. Wakeman, all on the same road.

Mr. G. H. Watkins has been appointed master mechanic of the Pennsylvania, with office at Pittsburgh, Pa. Mr. F. L. Dobson succeeds Mr. Watkins as assistant master mechanic of the Pennsylvania at Meadows Shops, Jersey City, N. J. Mr. J. P. Burns has been appointed foreman of locomotive repairs on the same road at Wellsville, Ohio, and Mr. G. L. Bennett has been appointed foreman of the car shops on the same road at Erie, Pa., succeeding Mr. G. C. Weight.

Mr. J. H. Daley has been appointed master mechanic of the New York, New Haven & Hartford, with office at Taunton, Mass. Mr. A. W. Nelson has been appointed to a similar position on the same road, with office at Waterbury, Conn. Mr. E. W. Alling, formerly master mechanic at Taunton on the same road, has been transferred to a similar position at New Haven, Conn., succeeding Mr. W. S. Clarkson, and Mr. C. H. Reid, formerly master mechanic on the same road at Waterbury, Conn., has been transferred to a similar position at Providence, R. I.

Charles W. Allen, manager of the railway department of the Reading-Bayonne Steel Casting Company, Reading, Pa., has been made vice-president and a director of the Reading Specialties Company, a company recently organized to sell the cast steel products of the Reading-Bayonne Steel Casting Company. The others who are also officers of the Reading-Bayonne Steel Casting Company are W. D. Sargent, chairman; J. Turner Moore, president, and H. M. Doty, secretary and treasurer.

Mr. Allen received his education in the Tamaqua schools and served an apprenticeship as machinist in the Tamaqua shops of the Philadelphia & Reading. After several years he was made engine house foreman at Milton, where he remained six years. In 1904 he was transferred to Reading as master mechanic of the Reading & Harrisburg division. He resigned this position on January 1, 1907, to become railroad representative of the L. H. Bordo Company, which position he retained until his appointment as manager of the railway department of the Reading Bayonne Steel Casting Company. Mr. Allen is a member of the Engineering

CHARLES W. ALLEN.

Society, the Franklin Institute and the American Railway Master Mechanics' Association.

Mr. Frank A. Purdy has been appointed sales manager of the Gold Car Heating and Lighting Company, and the Canadian Car Heating and Lighting Company. Mr. Purdy has been in the

FRANK A. PURDY.

employ of the former company as salesman since July, 1905, and in addition was appointed manager of the latter company at Montreal, Canada, in January, 1907. Mr. Purdy has the best wishes of his many friends, and in his double capacity is the right man in the right place.

Mr. H. A. Walker, formerly road foreman of engines, of the Scioto division of the Norfolk & Western, has been transferred to the Pocahontas division of the same road, as assistant trainmaster, with headquarters at Eckman, W. Va. Mr. J. O. Clendenan, assistant road foreman of engines of the Pocahontas division of Norfolk & Western, has been transferred to the Scioto division as general road foreman of engines with headquarters at Portsmouth, O.

Official Changes on the Erie.

Mr. J. C. Stuart, vice-president, in charge of operating department, assistant to the president. Mr. A. J. Stone, general manager, Erie division, general manager. Mr. R. S. Parsons, assistant general manager, Erie division, general manager, Ohio division. Mr. J. B. Dickson, superintendent New York division, assistant general manager Ohio division. Mr. H. O. Dunkle, general manager Ohio division, general manager Chicago division and lake lines. Mr. F. B. Lincoln, assistant to the receiver, P. S. & N. R. R., general superintendent Erie division. Mr. W. A. Baldwin, superintendent Delaware division, assistant general superintendent, Erie division. Mr. E. W. Batchelder, assistant general manager, Ohio division, general agent, Jamestown, N. Y. Mr. C. P. Eckels, superintendent, Wyoming division, superintendent, Delaware division. Mr. J. J. Mantell, terminal trainmaster, superintendent Wyoming division. Mr. E. R. Allen, general agent, Jamestown, N. Y., assistant superintendent of terminals. Mr. A. B. Shafer, assistant superintendent N. Y., S. & W. and W. B. & E. R. R., superintendent N. Y. S. & W. and B. & E. R. R. Mr. M. E. Johns, superintendent, N. Y. S. & W. and W. B. & E. R. R., superintendent of terminals, N. Y. S. & W.

Obituary.

JOHN WILSON THOMAS, JR.

On December 17 John Wilson Thomas, Jr., general manager of the Nashville, Chattanooga, & St. Louis, died in the fifty-seventh year of his age. Mr. Thomas was a son of the president of the same road, and was early destined for an official position, but voluntarily went through the very best training to make himself efficient in the higher lines of work. He was a man of tremendous energy and seemed to put his whole soul into whatever work he had on hand. We have known John W. Thomas as locomotive engineer, as conductor, as trainmaster, as office man and as assistant to the president, all of the positions being filled in a masterly manner that promised well for the service he would render when called to the head of the company. Mr. Thomas was a genial, warm-hearted official which made him popular with all classes. In his early death the railroad world has lost a credit to the business, and we lament the loss of a warm personal friend.

Improvements in Geared Locomotives

A device looking to the improvement of geared locomotives has been assigned to the Lima Locomotive Corporation. The object of the invention, as shown in the accompanying illustrations, is to furnish a means of supporting a combined locomotive and tender wholly upon wheeled trucks so as to facilitate in the highest degree the turning of the locomotive around curves, and at the same time to permit the accommodation of each truck wheel independently to the inequalities of the track, while geared together, and to the source of power upon the locomotive. This object is effected by making each axle-box movable independently in the truck, and providing each axle with a separate line-shaft section and gearing for driving the same, and connecting all the separate line-shaft sections flexibly together and to the power-shaft upon the locomotive.

The improvements also include a locomotive tender having one or more multiple-wheeled trucks so arranged as to admit of the application of power to all its pairs of wheels by a system of line-shafting on one or both sides of the tender. In such construction the axles in the truck or trucks are geared to sections of line-shafting upon one of the locomotive-trucks, thus securing perfect flexibility in the transmission of the power to the truck wheels under the tender.

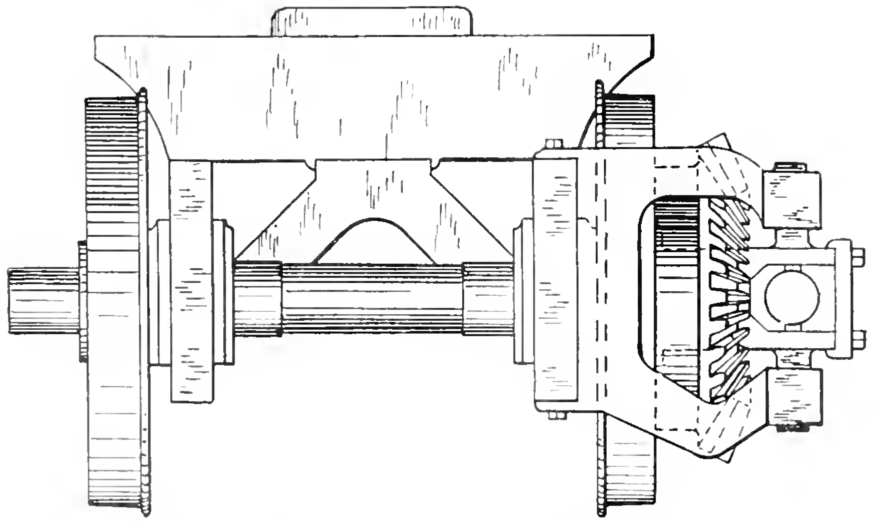


FIG. 1. SECTION VIEW OF INDEPENDENTLY CONNECTED TRUCK.

The appliance is obviously applicable to a locomotive having its motor operated by steam, electricity, gas or any other agency, and the crank shaft may be geared in any suitable manner to each axle in each truck so as to drive all the truck wheels independently, while permitting them to play independently in their truck frames when passing over inequalities of track. The illustrations, Figures 1 and 2, show the wheels overhung upon the axles and provided each with a bevel gear upon its outer side. Each axle has a projecting end or extension upon which a transverse shaft-box is fitted, and is held from turning upon the axle-extension by guide arms, movable vertically in guides which are bolted by arms to the upper and lower

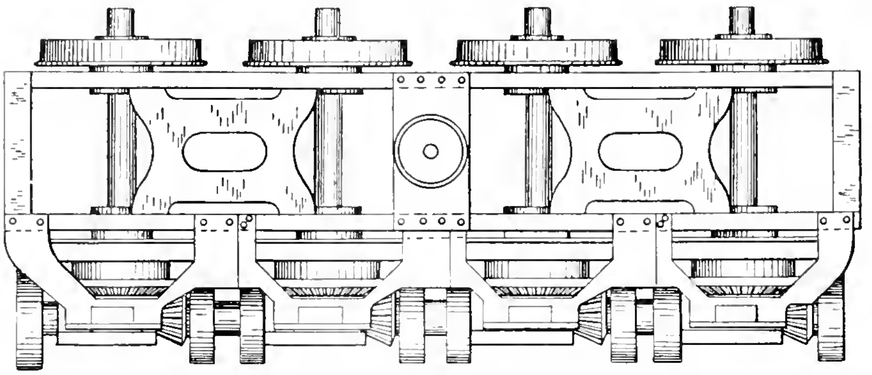


FIG. 2. PLAN SHOWING INDEPENDENT SHAFTING.

edges of the adjacent truck-frame. A shaft-section is carried in the shaft-box and has a bevel pinion to drive the gear. Each axle is thus furnished with an independent section of the line-shaft and is coupled to the adjacent section by driving-rings and sliding extension-bar. The axle-bearings are thereby permitted vertical movement in their pedestals to allow variation between the truck-frames and the truck-wheels, such variation being necessary whenever the truck is in motion and has local oscillation owing to track inequalities or disturbances in the load carried by the bolsters. The truck-wheels of the tender are also driven separately by bevel-gearing, which is connected with the line-shaft upon the rear truck under the locomotive-frame.

The principal of the device, therefore, is a perfect flexibility of each wheel independently of the others, the axle boxes being movable vertically, the separate line-shaft sections being also movable vertically with each axle constituting mechanism flexibly connecting such shaft sections with one another and with the power shaft by means of universal joints. Mr. W. A. Austin and Mr. L. E. Feightner, both of Lima, Ohio, are the joint inventors, and the device is expected to be in operation shortly.

Re-Introduction of Compound Locomotives on Swedish State Railways.

According to the *Zeitschrift des Vereins D. E. Verwaltungen,* the compound system of expansion will be adopted in a number of the new "Pacific" type locomotives to be known as Class F, which is to take the place of the previous Class A.

Until recently it had been held that the use of superheated steam provided all the economy that was desirable, with sufficient power and with reduced boiler pressures. But the compound system, used to some extent in Sweden before superheaters were on the market, will be again employed and at the same moderate pressures of 13 kgs. per c/m. sq. (184 lbs. per sq. in.) as employed for the Swedish two-cylinder saturated-steam compounds.

The new "Pacific" compounds, now building by Nydquist and Holm, of Trollhaettan, are designed for maximum speeds of 127 k. m. per hour (79 miles per hour); they are required to haul trains of 360 tons at a speed of at least 62 miles per hour on level line and at 37 miles per hour up grades of 1 in 100. The boiler will supply steam at a maximum pressure of 184 lbs. to two cylinders of 16½ in. diameter by 26 in. stroke; the exhaust steam will be passed to two cylinders 24¾ in. diameter by 26 in. stroke; the ratio being only 1:2.25 is calculated to effect an economy under, rather than over, 25 per cent. The driving wheels are 70¾ in. diameter with an adhesion of 16 tons per pair, or 48 tons total. The weight on the front truck wheels is 21 tons and on the trailing wheels 15.5 tons. The weight empty is 76.5 tons and loaded 84.5 tons. With tender, the entire weight is 137 tons. The boiler has a total heating surface of 24.7 sq. m.

RAILROAD NOTES.

The Michigan Central has plans for new shops at Bay City, Mich.

The Illinois Central is in the market for 150 express refrigerator cars.

The Erie has ordered 7 mail cars from the Standard Steel Car Company.

The New Jersey, Indiana & Illinois is reported in the market for 100 freight cars.

The Atlantic Coast Line has ordered 25 phosphate cars from the Pressed Steel Car Co.

The Missouri Pacific has ordered 25 Mikado locomotives from the Baldwin Locomotive Works.

The Lehigh & New England has ordered 500 steel hopper cars from the Pressed Steel Car Co.

The Union Pacific, says a report, is inquiring for 4,000 box cars, 600 automobile cars and 400 stock cars.

The Northwestern Pacific is in the market for 4 eight-wheel passenger and 2 ten-wheel freight locomotives.

The Louisville & Nashville has ordered 18 all-steel passenger cars from the American Car & Foundry Company.

The Norfolk & Western, it is said, is preparing to construct a 22-stall roundhouse and shops at Williamson, W. Va.

The Pennsylvania Railroad has ordered 16 combination passenger and baggage cars from the American Car & Foundry Co.

The Lehigh Valley has let contracts to the Standard Steel Car Co., Pittsburgh, Pa., for 100 all-steel cars for passenger equipment.

The Intercolonial is said to have ordered 16 consolidation and 10 switching locomotives from the Canadian Locomotive Company.

The Oregon Short Line will erect a new passenger station at Pocatello, Idaho, as soon as enlargement of shops and yards has been completed.

Work has commenced at Marshall, Tex., on a 25-stall roundhouse for the Texas & Pacific, to replace the one recently destroyed by fire.

The Grand Trunk Pacific has compiled a list of tools it contemplates purchasing soon for the company's shops. The expenditure will aggregate $150,000.

The transit lines of New York City during the year which ended on June 30, carried 1,769,889,284 persons. The total population of the earth is estimated at 1,623,300,000.

The Chicago, Burlington & Quincy is reported to be considering the erection of shops and other buildings at Derby, Colo. It is stated that switching yards with nine miles of track will be built.

The Norfolk & Western plans during the coming year to install automatic block signals on 20 miles of its lines, as follows: Suffolk to Myrtle, 6 miles; Windsor to Dwight, 5 miles, and Disputanta to Poe, 9 miles.

The Federal Signal Company has taken the contract to install a mechanical interlocking plant for the Philadelphia & Reading at Roelof, Pa. The machine will have 44 levers. Alternating current track circuits will be installed.

The Southern Railway of Peru has ordered 4 consolidation locomotives from the American Locomotive Co. The dimensions of the cylinders will be 16 in. x 26 in., the diameter of the driving wheels will be 52 in., the steam pressure will be 180 lbs., and the total weight in working order will be 110,000 lbs.

The New Jersey, Indiana & Illinois has ordered 1 mogul locomotive from the American Locomotive Co. The dimensions of the cylinders will be 18 in. x 24 in., the diameter of the driving wheels will be 50 in., the steam pressure will be 165 lbs., and the total weight in working order will be 120,000 lbs.

Contract has been awarded to James A McIlwee & Sons, Denver, Colo., to drive a five-mile double track tunnel through the mountains at Rogers Pass, 224 miles west of Calgary, Alta. A smaller and parallel tunnel will be driven with crosscuts to the main survey at every 500 feet and stations will be established from which headings will be run in either direction.

The Chicago & Northwestern, reported in these columns as having ordered 20 Mikado, 12 Pacific, and 18 switching locomotives, has ordered 40 Mikado, 12 Pacific, and 18 switching locomotives from the American Locomotive Works. There have also been ordered from the same company 4 superheater Pacific locomotives and 6 superheater Mikado locomotives for the Chicago, St. Paul, Minneapolis & Omaha. The Pacific locomotives will have cylinders 25 x 28 ins., driving wheels, 75 ins., and total weight in working order, 260,000 lbs. The Mikado locomotives will have cylinders 27 x 32 ins., driving wheels, 61 ins., and total weight in working order, 300,000 lbs.

To Search for Tuberculosis on Trains.

There is in Washington a bureau called the Public Health Service which seems to be laboring all the time for excuses to put restrictions upon railway companies calculated to conserve the health of travelers. Their most conspicuous performance was getting laws passed forbidding the use of drinking cups in cars, which inflicts torture upon a great many helpless people who fail to provide themselves with drinking cups

The latest move of this officious bureau is the pretense to protect travelers and trainmen from tuberculosis. With a view to legislation or interstate quarantine regulations, surgeons of the health service have been assigned to California, North Carolina and Texas, to ascertain how travel affects tuberculosis victims, the effect of their proximity on the health of railroad employees and passengers on trains in which such persons travel, the health of the communities in which they settle and possible contagion in other directions.

Honoring Mr. Westinghouse.

Mr. George Westinghouse, the eminent engineer and inventor, has been presented with the Grahof Medal. The award was made last summer by the Verein Deutscher Ingenieure at the joint meeting of two engineering societies in Germany last summer. The final presentation of the medal to Mr. Westinghouse was done at a meeting in the room of the American Society of Mechanical Engineers in December.

GRASHOF MEDAL AWARDED TO GEORGE WESTINGHOUSE.

A New England Company Honored.

The American Mason Safety Tread Company, Lowell, Mass., was awarded a gold medal at the International Exposition of Safety and Sanitation, held under the auspices of the American Museum of Safety at the Grand Central Palace, New York City, December 11th to 20th, 1913.

Removal.

The Nathan Manufacturing Company has removed its general offices from 85 Liberty street, New York, where it has been established for many years, to more commodious quarters at 101 Park avenue, corner of Fortieth street, New York.

Accident to John Mackenzie.

On November 3, while alighting from a street car, John Mackenzie, so well known as past superintendent of motive power of the Nickel Plate Line was struck by a car going in the opposite direction and very severely injured. He was taken to a hospital where he still lies in a very precarious condition.

Peat Powder as a Locomotive Fuel.

Peat powder has been successfully applied as a locomotive fuel on one of the private railroads in Sweden. In steam raising value about 1½ tons of peat powder is equivalent to one ton of coal. Peat powder is used with a mixture of about 5 per cent. of coal, and is fed into the furnace by an automatic stoker. No change need be made in the boiler end in the fire-box, except for the mounting and application of the automatic stoker. An incidental advantage of the use of the peat powder is that no cold air can get into the fire-box and no smoke or sparks escape from the smoke-stack. As Sweden is very rich in peat bogs, and has practically no coal deposits, the success of the apparatus, which has been worked upon for years by eminent engineers, is of considerable importance It has been estimated that the cost of peat powder would be only about one-half that of coal.

Make Sure.

Mr. Lloyd George, who is a humorous Welshman, has been telling some stories bearing on his own unpopularity with his political opponents. One of them is about a man who was presented with a testimonial for saving some one from drowning. The hero modestly deprecated the praises showered upon him. "Really I have done very little to deserve this reward," he said. "I saw the man struggling in the water, and as no one else was by I knew he would be drowned if I didn't save him. So I jumped in, swam out to him, turned him over to make sure he wasn't Lloyd George, and then pulled him out!"

Action Not Natural.

Two Hoboken misses not old enough to attend school were taking notes of things.

"What makes a horse act naughty when he sees an auto?"

"It is this way: Horses is used to seein' other horses pull wagons, and they don't know what to think of 'em goin' along without a horse. Guess if you saw a pair of pants walkin' down the street without a man in 'em you'd be scared, too."

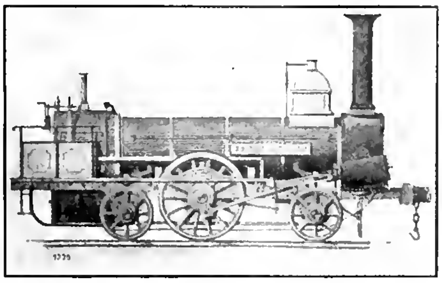
Avoid the luxury that becomes a necessity.

Platitudes are the things that people of plain minds shout from the steps of the staircase of life as they ascend.

Books, Bulletins, Catalogues, Etc.

The Hanomag Journal.

The tendency of large industrial institutions to publish a house organ or periodical of their own has reached Germany. The Hanover Locomotive Works, at Hanover-Linden, has just issued No. 1, of the *Hanomag Journal,* and if the succeeding issues are of equal interest the publication will be looked for by railroad men. It sets forth the history of the development of the Hanover Locomotive Works in an engaging way. It begins with the biography of John Egestorff (1772-1834), who changed the village of Linden, renowned for its gardens, into an industrial town, giving employment to thousands. Like Charlemagne, the great soldier, Egestorff could neither read or write, but he started a limekiln, then he worked lignite fields in the neighboring hills, then founded a timber business, a brick yard and a sugar factory. Then he improved the roads and the waterways. Then he turned his attention to engineering. Then his son George took a hand in expanding the industries in Hanover. In 1832, he established the great salt works at Badenstedt, and in 1835, the foundry and engineering works at Linden; in 1839, the chemical works at Linden; in 1856, the ultramarine works at Limmer, and in 1856, the ammunition works at Linden.

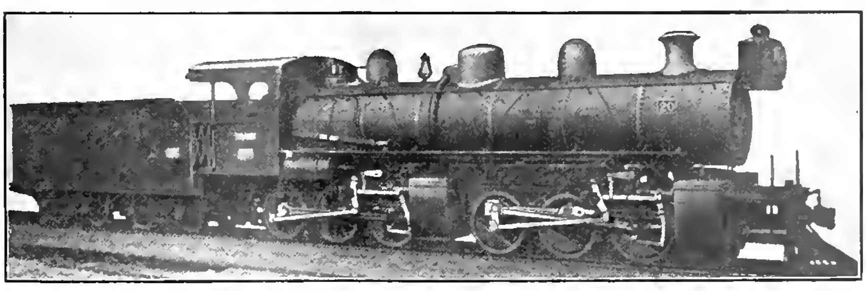


THE FIRST LOCOMOTIVE BUILT IN THE EGESTORFF WORKS. 1846.

Then Dr. Strousberg came from Prussia and took a hand in the good work. He began by building railways. His first locomotive was built in 1846 for the Hanoverian State Railways. It was patterned after the British locomotives. It weighed 24 tons. The cylinders were 14 inches x 21 inches. The driving wheels were 60 inches in diameter. Grate area 775 sq. ft. He constructed a dozen railways in the German States and in Prussia, Austria and Roumania. He established iron and steel works, coal mines and machine shops, and was practically independent of subcontractors.

The Egestorff Engineering Works, whose output Dr. Strousberg had increased five-fold was acquired by the "Hanomag," and the company now turns out about 500 locomotives a year. The other departments have also kept pace with the locomotive department. Milling and planing machines, pneumatic tools, plants for welding and cutting by means of the autogeneous process, forging and flanging presses, hydraulic rivetting machines are installed in large numbers and suffice for machining the largest pieces that are likely to be manufactured in any of the departments even in a distant future. The works, which are being constantly extended, cover about 50 acres and give employment to nearly 5,000 men

Coincident with the increase in locomotive construction the Egestorff works kept pace in other directions. The first marine steam engine left the works in 1856, and in the same year the 100th locomotive was completed in this establishment. The good reputation which the works enjoyed helped them to take up with success the manufacture of other kinds of machinery; the construction of hydraulic cranes, pumping machinery, elevators, blowing engines, winding engines for mines, etc., traction engines, saw-grates, milling machinery and shafting were taken up in succession. Many of these engines and plants were renowned in those days and were amongst the largest of their kind in Germany. Amongst others we might mention the hydraulic cranes of the port of Geestemünde and the large pumping plant for the fountains at Hanover, Herrenhausen and Brunswick. The old-fashioned pumping plant belonging to the Herrenhausen fountains is still in use. This plant was supplied in the year 1862. Besides the above, the Egestorff works also manu-



MALLET LOCOMOTIVE FOR THE ARICA-LA PAZ RAILWAY, CHILE.
Egestorff Works, Hanover-Linden, Germany, Builders.

factured steam fire-engines, steam and water heating plants of their own special type.

The management of the works gradually saw that it was necessary to limit the manufacture to a few specialties, viz.: steam engines, pumps and winding engines in addition to locomotives. Whilst carrying out this principle the firm followed closely the progress made in their specialties and in the course of time took up the manufacture of a few more special lines such as Stirling water tube boilers and installations for workshops (scalding plants for bogies, wheel sets, etc., and cast iron plate-rails).

We reproduce an illustration of the first locomotive built in the establishment, as we have already stated, in 1846, and which was named "Ernst August" in honor of the King of Hanover, and also one of the Mallet (0-6-6-0) type built a year ago at Hanover-Linden for the Arica-La Paz Railway of Chile. This fine type of locomotive is built for the metre gauge $39\frac{3}{8}$ inches, weight in working order, 61.6 tons; cylinders, $15\frac{3}{4}$ ins. and 24 ins.; length of stroke, $21\frac{3}{4}$ ins.; diameter of driving wheels, $43\frac{1}{2}$ ins.; grate area, 30 sq. ft.; heating surface, 1,990 sq. ft.; pressure, 199 pounds. The reports in regard to locomotive as a mountain climber are of the best, and is a proof, if proof were needed, that the Egestorff works are maintaining the high standard of excellence in locomotive construction which the company has maintained for nearly half a century.

Safety Calendars.

Among the latest publications, Safety calendars are appearing, and that issued by the National Tube Company being particularly interesting on account of the pointed lessons presented. The illustration accompanying the calendar entitled "Taking No Chances," was selected out of about a dozen different pictures submitted, and is a real work of art. We understand that the company are enforcing their code of safety rules in their own extensive mills, and the employees are co-operating in a way that shows that the safety habit, like all other habits, grows with time. An artistic calendar is an attraction in itself, and the safety rules and maxims are being constantly impressed upon the mind while scanning the calendar.

Electric Steel Castings.

The National Malleable Castings Company, Sharon, Pa., have just issued a pamphlet treating of electric steel castings, which is particularly interesting in view of the fact that an excellent description is given of a series of tests of electric and open-hearth steels, of almost identical analysis with the results largely in favor of electric steel. The process of making is described, and many years have perfected the system until the material has reached the highest degree of purity and uniformity, combined with great toughness. Almost entire elimination of sulphur is possible by the electric method, as well as complete control of the other elements. Many advantages are claimed by the method not only in locomotive frames and other heavy work, but also in the lightest kinds of steel castings. Copies of this interesting pamphlet may be had on application.

Pacific Type Locomotives.

The monthly bulletins issued by the American Locomotive Company are of much interest, as they furnish a vast amount of information in regard to locomotive performance under a variety of conditions, and with different kinds of fuel. The latest copy of the Bulletin presents illustrations of 42 locomotives of the Pacific type from the powerful Pennsylvania engines, having a tractive power of 43,300 pounds, to the lighter engines of the Chesapeake & Ohio, and the Seaboard Air Line, having a tractive power of a little over 30,000 pounds. Over 40 railroads furnish data for the tables from which the record is drawn, and the marked superiority of the Pacific type of locomotive for certain kinds of service is clearly demonstrated. Copies of the Bulletin may be had on application at the company's office, 30 Church street, New York.

Increased Railroad Rates.

At a hearing before the Inter-State Commerce Commission in regard to the increased freight rates, it came out that adjustments of rates had been made in many leading countries on account of the increased cost of operation. An able article by M. C. Colson, the eminent French economist, has been reprinted in pamphlet form and extends to 24 pages. A perusal of the publication is completely convincing of the fact that a certain increase in railway rates must necessarily follow upon a general increase in prices, and that soon, perhaps, the State will no longer be able, in fairness to refuse the increase to the railways. The republication of the pamphlet is timely and interesting.

Our New Chart.

The first edition of our new chart, consisting of twenty-five thousand copies, showing a section view of the complete details of a Mikado type locomotive with every part named and numbered, has been received with great popular favor by railroad men generally. Copies have been forwarded to all of our subscribers. Any subscribers whose copies has failed to reach them should notify us, and another copy will be promptly forwarded. It is also on sale at twenty-five cents per copy. It is not only the best chart that we issued, but it is the best thing of its kind ever published.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, February, 1914. No. 2

From Great Salt Lake to Southern California

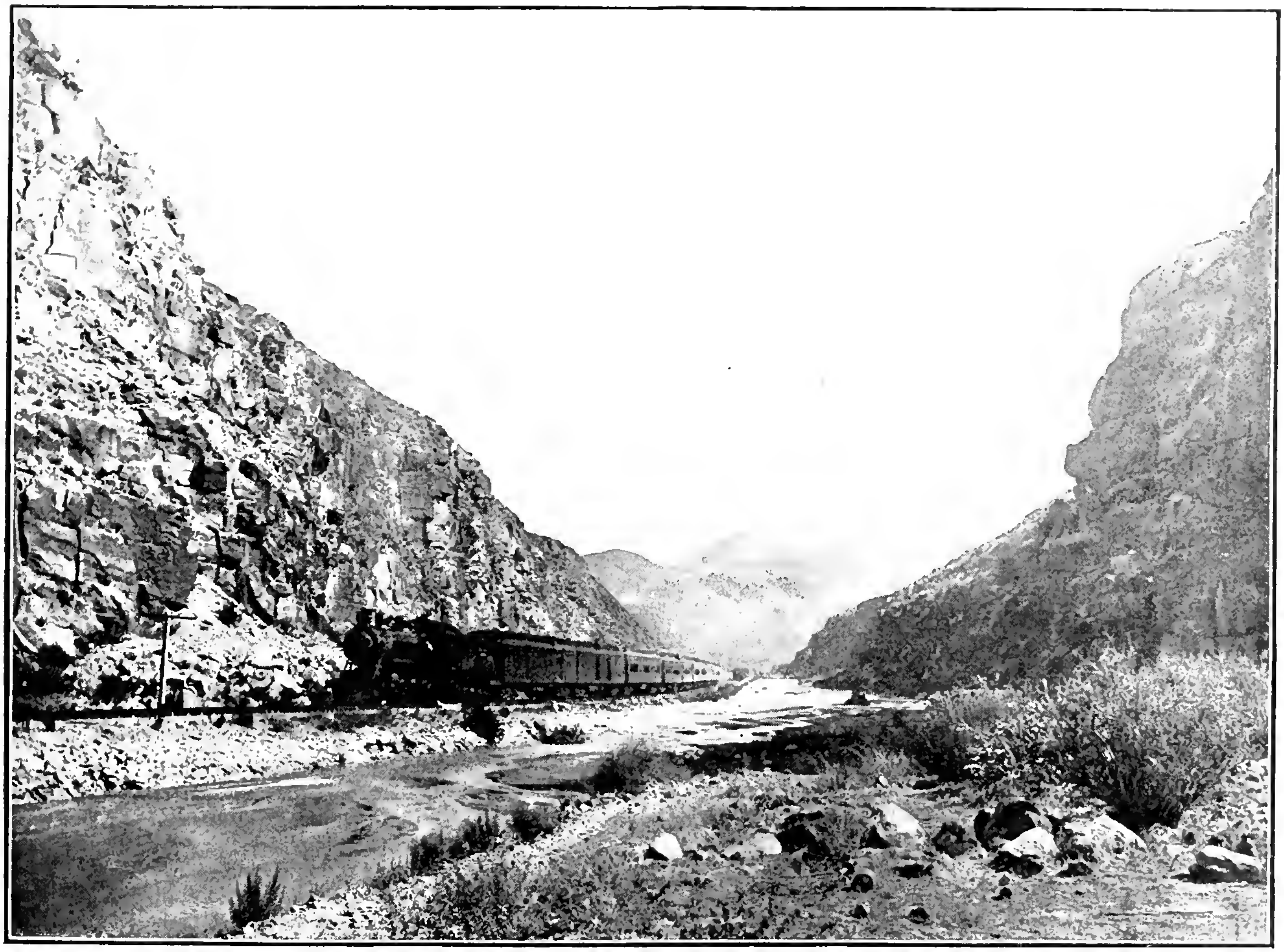
To the traveler in the swiftly flying trains of the San Pedro, Los Angeles and Salt Lake Railroad (Salt Lake Route) a few words of history may be of interest.

For nearly the entire distance this short line between Salt Lake City and Los Angeles follows the trail of the Mormon pioneers, who, in 1851 journeyed from Utah to San Bernardino, California, to locate in the valley of the Arrowhead, a new colony of the Mormon people.

Behind the ox-team on the old trail came the lumbering prairie schooner, guarded before, behind, and on both sides by riflemen; bearing beneath its curtains the precious freight of wives and children who followed, for four weary months, the hardy pioneers of the West into the Land of Promise. Today, over almost the same trail, roll the well-lighted, comfortably cushioned cars of the Salt Lake Route, hotels on wheels, bearing the wanderer in comfort such as he knows only at home.

Leaving Salt Lake City, trains of the Salt Lake Route pass along the shore of the Great Salt Lake, a vast inland sea whose presence has never been explained, and whose wonders have never half been told.

Rounding the shoulder of the Oquirrh range, the line passes into the mining districts from which much of Utah's mineral wealth is obtained, and which has contributed materially to the upbuilding of Salt Lake City.



SCENE IN RAINBOW CANYON, MEADOW VALLEY WASH, NEVADA, ON THE SALT LAKE ROUTE.

Thence to the Nevada border, the former desert conditions are fast giving way to agricultural development by irrigation and dry farming, the rich soil showing surprising results within a short time after operations have been commenced.

Immediately after crossing the line between Utah and Nevada the character of the country changes, and for many miles the way is through a series of canyons, many gorgeously colored and of rugged, fantastic scenic beauty.

About midway in this mountain region is the valley of Caliente, so called from the hot springs there existing. The town is a division point of the Salt Lake Route.

Immediately after leaving Caliente myriad-hued buttes rise on every side; along the track flows a river; on every hand great gashes sear their way back into the heart of a wilderness of hills more beautiful than the famed "Bad Lands" of Wyoming.

Somber grays and browns of lower slopes give way to blues and greens and reds and yellows on the upper shelves of the buttes, until all finally merge in the most gorgeous of all the panoramas on the way westward—Rainbow Canyon. Down this gorge, carved by the mad water centuries ago, its walls a jumbled mass of ores and igneous rock, all garbed in such shades as no painter ever dared to mix on his palette, the Salt Lake Route train plunges, one hundred miles from its last stop at Caliente.

Out of this canyon the train rolls down into the rich Las Vegas Valley, its settlement founded more than a hundred years ago by the Spanish padres and later given over to Mormon settlers who have in turn been followed by other settlers, attracted by the fertile soil and abundant artesian water supply.

From Las Vegas to the San Bernardino mountains, in California, the real desert is traversed. While not notable for scenic attractions, at certain times of the year the desert is beautiful with a great variety of flowers, and portions of it, such as the Devil's Playground, with the swirling sands, and the Mojave River Canyon, with its fantastic rock formation, are interesting features of the traveler's journey.

Crossing the mountains through Cajon Pass, the real California, with its orange groves, palms and flowers is first seen near San Bernardino. On the left is Arrowhead Mountain.

Heavy with Indian and white men's legends is this arrowhead; from it the famous Arrowhead Hot Springs, nearby, were named, and from it the Salt Lake Route took its equally famous trade-mark. Clear and distinct, regular in outline as if carved with some Titan's chisel, this strange landmark has been a puzzle to geologists. How it came there, or when, no man knows.

From San Bernardino to Los Angeles is a continuous panorama of thriving cities, set in the midst of thousands of acres of orange and lemon groves, wine grape vineyards, walnut and peach orchards and truck farms, the towering Sierra Madres guarding the northern side of the valleys.

From Los Angeles the Salt Lake Route continues onward twenty-one miles to Long Beach, a city of 30,000, thence six miles farther to its Pacific Coast terminus at San Pedro Harbor.

Traffic arrangements with the Robert Dollar Co. enables the San Pedro, Los Angeles and Salt Lake Railroad Co. to enter the trade with the Orient, in connection with the Dollar Co. steamships from San Pedro Harbor, the port of Los Angeles.

With its excellent train service the Salt Lake Route is an important factor in the trans-continental passenger and freight business to and from Southern California.

Two limited daily trains, with the best of Pullman equipment, run solid in less than three days, between Chicago and Los Angeles, the Los Angeles Limited via the Chicago Northwestern and Union Pacific Railways, and the Pacific Limited via Chicago, Milwaukee and St. Paul and Union Pacific railways; connecting sleepers with these trains, run to and from St. Paul, St. Louis, Kansas City and Denver. Other trains have through sleepers between Los Angeles, Chicago, etc., via Salt Lake City and various routes east thereof.

General direction of all traffic matters is in charge of F. A. Wann, general traffic manager, T. C. Peck, general passenger agent, and T. M. Sloan, general freight agent—all with offices in Los Angeles.

Panama-Pacific Exposition.

Rapid progress continues to be the feature of the work on the Panama-Pacific Exposition. The great exhibit palaces now rapidly rising and the numerous lesser structures of many kinds combine to form an Exposition City of striking effect, in the process of making. Each day reveals progress in its evolution that is little short of amazing, when the vast scope of the undertaking is considered.

More than 6,000 applications for concessions have been received to date by the Division of Concessions and Admissions, and more than 100 have already been granted.

One hundred and seventy-seven congresses and conventions of various organizations have been arranged for the exposition year in San Francisco, and negotiations are in progress with many more organizations in different parts of the world, for some of the congresses will be international, others national and others yet pertaining only to the Pacific Coast of the United States. The organizations that have already agreed to hold congresses and conventions in San Francisco in 1915 include those representing civic, religious, social service, educational, fraternal, business, labor, commercial, horticultural, livestock and other interests.

The most conservative estimates, by careful investigators, place the minimum attendance of the Panama-Pacific International Exposition at 10,000,000, while most of them place the total at figures varying between 12,000,000 and 18,000,000.

Opening of Indo-Ceylon Railway Delayed.

It is officially stated that the formal inauguration ceremony in connection with opening the Indo-Ceylon Railway, which was previously scheduled to take place early in January, 1914, will not be celebrated before the first week in March, the actual time depending upon the date of completion of the system, which it is now estimated will be about the middle of February.

The Indian side of the work is reported as practically finished, and it only remains for the Ceylon authorities to complete their section of the undertaking, which is progressing favorably. The construction of the roller bridge which spans the Paumbem Passage on the Indian side is rapidly nearing completion, and the engineers are now counting upon the proper settling of the bank of the railway between Madawachi and Talaimannar, which has heretofore been retarded through absence of rain.

The opening of this important railway will constitute an immense improvement over existing transportation facilities between India and Ceylon and will be of material benefit to both the passenger and freight traffic. Incidentally the transit period will be shortened by several hours, not to mention the elimination of the present necessity of a night's journey by sea between Tuticorin and Colombo.

Safety on the Pennsylvania.

Reports to the General Office indicate that not a single passenger out of 111,000,000 carried by the Pennsylvania Railroad Company in 1913 was killed in a train accident.

Reports for the past six years show that almost 600,000,000 passengers—more than one third of the whole world's population—have been carried by the Pennsylvania Railroad, and but sixteen of them lost their lives in accidents to trains; nine were killed in one accident. In six years, out of approximately 5,000,000 trains operated—about 1,370 a day—only five have suffered wrecks which caused the death of any of the passengers carried on them. Three of these years were entirely free from train accidents causing the death of passengers.

Southern Locomotive Valve Gear

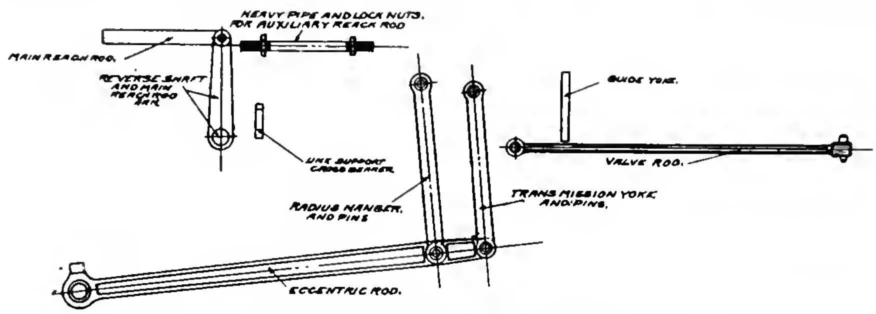
A new type of locomotive valve gear has been introduced on the Southern Railway, and has been in operation on some of the freight and passenger engines, and its operation is highly spoken of by some of the leading railway men there. One of the freight engines, No. 586, has been running for over twelve months with the gearing, and no repairs of any kind have been made on the valve gear, and it is also claimed that hardly any perceptible wear is shown on any of the parts.

The accompanying illustrations show the general design and details of the gearing. It is very simple and compact, and contains but few wearing parts. Counterbalance springs, counter-weights, also crosshead connection has been dispensed with, and as a consequence there has been a corresponding reduction in weight. It is claimed that if the valves are properly adjusted at the time the engine receives general repairs, the gear is so designed as to eliminate the necessity for any adjustment in the blacksmith shop while the engine is in service.

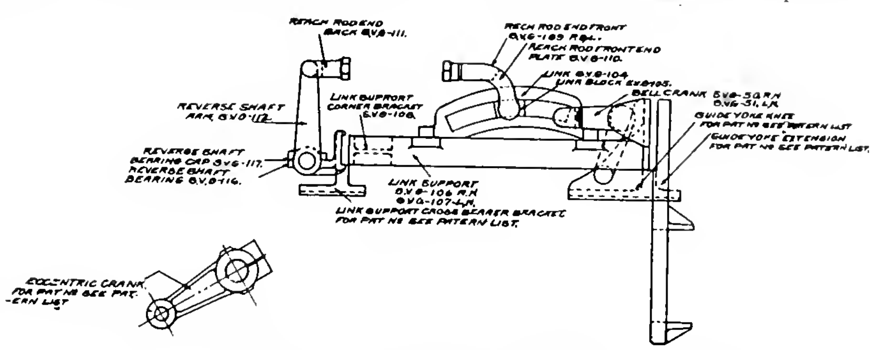
In the matter of transferring from a rotary motion to a reciprocating motion, it is accomplished by direct movement and on straight lines, doing away with strains and distortions so injurious in the Stephenson valve gear. The links being located in a horizontal position and being stationary, entirely does away with wear at this point, as the block only moves in the link when the reverse lever is moved to adjust cut-off or reverse gear. The link being stationary, it is also claimed that this eliminates what is known as the slip in the link block, found in some valve gears. There are but eight possible points of wear on each side of the locomotive or a total of sixteen points, this being less than half contained in the average of some other gears.

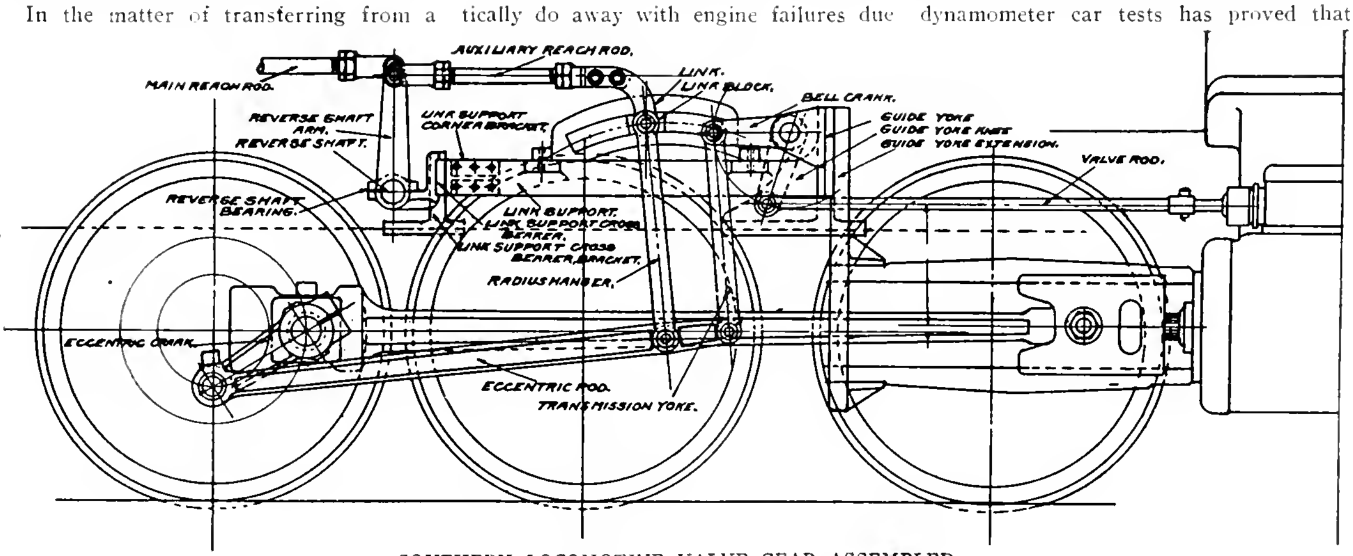
It is also claimed that the gear will practically do away with engine failures due to breakage of valve gear parts. The various parts are so balanced as to reduce wear on the pins and bushings to a minimum. A 22 x 30 inch freight engine equipped with this gear, after making over 30,000 miles, does not show any appreciable wear as already stated; neither has there been any cost in the matter of repairs to the valve gear parts. The pins and bushings are of such size as insures long usage without wear. The forward end of the eccentric rod is supported by a bell-crank hanger, which has at its top two bearings spaced widely apart, thus absolutely preventing any side shock on eccentric rod.

A prominent feature of the gear is the ease with which the reverse lever is handled. There is literally no stress or strain upon the lever and reach rod connections. The danger in handling reverse levers of the ordinary type under steam pressure is a growing danger. The avoidance of this trouble appeals very strongly to the engineer, as it enables him to adjust the cut-off without any risk of the reverse lever getting beyond his control, and as a consequence he readily and frequently adjusts the lever to meet the requirements of the situation. This results in a greater saving of fuel than might be imagined—a series of dynamometer car tests has proved that the gear will stand the hard usage incidental to heavy freight traffic. It is generally admitted by those who have had opportunities of observing the gear that it is now past the experimental stage, and that it has proved itself to be a money-saver in railroad service.



WROUGHT FORGINGS IN SOUTHERN LOCOMOTIVE VALVE GEAR.


STEEL CASTINGS IN SOUTHERN LOCOMOTIVE VALVE GEAR.



SOUTHERN LOCOMOTIVE VALVE GEAR ASSEMBLED.

General Correspondence

Poorly Paid Machinists

EDITOR:

Nothing that has appeared in RAILWAY AND LOCOMOTIVE ENGINEERING for some time, has excited so much attention of shop men as your article on page 8 of the January number, if I am to judge by the amount of discussion heard in railway shops and round houses. In this connection it would be proper to investigate the cause which has made the machinist of less consideration in the eyes of his employer than other tradesmen who used to be thought inferior to the machinist. The strongest influences in reducing the machinists' work has, of course, been the introduction of power-operated tools into every department of metal fitting and finishing that used to be done by hand.

There is another thing working strongly against first-class machinists, that is, the half fledged machinist and such animals as locksmiths and assemblers of sewing machines and automobiles. These people acquire some familiarity with the shoving of a file and are readily taken on by some machine shop foremen who regard cheapness before efficiency. Other tradesmen protect themselves from the interloping of pretended mechanics by means of unions which have proved highly efficient for this purpose, and I can see no good reason why machinists should not adopt and make the best of the same policy.

JOHN REARDON.

Brooklyn, N. Y.

Hard Working Slide Valves.

EDITOR:

In the December number of RAILWAY AND LOCOMOTIVE ENGINEERING I noticed on page 426 some remarks by Mr. R. H. Williams, of Cincinnati, O., relative to the remarks made by me in the Traveling Engineers' Convention on the use of slide valves in connection with a superheater on an engine which we are testing out; also, as stated, an invariable extra expense in trying to lubricate these valves. Mr. Williams' statement is borne out by the records, as to train delays and engine failures due to eccentric straps and other troubles, and that is why mechanical talent is trying to get away from the Stephenson valve gear.

I note he recommends a light throttle and a long cut-off. Mechanical talent has dealt with this a long time, and it is a well-known fact that this will overcome the hard working of the valves, if we care to wire-draw our steam and not get the expansion in the cylinder. It is impossible to place the nozzle of a garden hose in the middle of the nose and expect to get the results at the end. I want to state further that our wise men of the mechanical world have spent years of their lives in experimenting on different problems, such as hard-working valves, and several devices have been put on the market to overcome the friction, and to get the results, and (as Mr. Williams states) the records will show that train delays and other breakdowns due to broken eccentric straps and other parts of the Stephenson valve gear made a problem which confronted mechanical talent for years, and in the last few years the Walschaerts valve gear has come to us, and there are now a great many railroads which have on hand a great deal of power that is not equipped with these great saving devices, which they are all anxious to get, not only from an economical standpoint but for convenience. Also, in taking Mr. Williams' statement where he gives the superheater credit for hauling many more tons of freight than the saturated engine, it is to be understood that this device was not intended to haul more tonnage, but to handle the same tonnage with better satisfaction and at less expense, and is able to do just what it was intended, if maintained as it should be. It is a well-known fact that the two largest items of expense of a railroad are the fuel and the maintenance of boilers. The superheater has come closer to this point than anything yet on the market. The greatest mechanical men of the world have been busy for years trying to solve that problem of economizing on fuel, water, and steam, in several ways, such as drafting, short cut-offs, close-notched quadrants for fine graduations; then the compound engine came into existence to get all possible expansion out of the steam before relieving it at the exhaust, and it is considered good practice to use a wide open throttle valve with a short cut-off when practicable to do so, in order to get the best and most economical results and receive the benefit of the heat placed in the water to make the pressure. As I stated at the convention in Chicago, I was not at that time prepared to make a very encouraging report of our experiment, but can say this engine I speak of is of light construction, being built by the American Locomotive Company at their Brooks shops in 1904, weighs 87,000 pounds, with 18-inch cylinders for a saturated engine, and was converted to a superheater engine and made her trial trip September 23, 1912, and since that time has been running in passenger service, on a division of 132 miles, where, as explained, we used the Jack-Wilson Bronze Valve, made by the American Valve Company, and this valve comes as near being perfect as any slide valve on the market, and we have watched it closely, and can find no wear to speak of. The valve oil allowance is 2¾ pints for a run of 264 miles, with forty-two regular stops. We have no difficulty in lubricating this engine, but as stated, we have had some trouble in the wear on the valve gear which I attribute to the Stephenson valve gear, as the power exerted on the piston follows back to the main driving wheels, eccentric links and blocks, and with the light construction of the engine, to which I attribute this trouble.

After the engine is placed in the shops for general repairs, I may be able to make a more satisfactory report, and I hope Mr. Williams can give us something specific to work from, or that would assist us in overcoming these difficulties without interfering with the economy of the engine, for I am not in favor of wire-drawing the steam, or the extravagance of using it in the cylinders with a long cut-off, as our boilers are now taxed to their full capacity.

W. R. DAVIS,
Road Foreman of Engines.
Toledo & Ohio Central Railway,
Columbus, Ohio.

Machinists' Wages.

EDITOR:

It was gratifying to read in last month's issue of RAILWAY AND LOCOMOTIVE ENGINEERING the views of your correspondent, W. Richardson, on the subject of "Poorly Paid Machinists." Not only were the statements all true and forcibly presented, but as a matter of fact, they did not go far enough. He alluded to the custom of many of the railroad machine shops closing for a couple of days or more after a holiday occurs. He is getting off easy. I know a number of places where the shops were closed on Christmas Day and did not open again until January 5. The custom is so general that it is hardly fair to point out particular places. It would be a good subject for the Interstate Commission to take up during their unat-

tached periods of apparent idleness. But politicians never look for extra work. Their chief end-in life is to get themselves placed, and then rest on their oars and drift with the tide, and occasionally trim their sails to suit the change of wind. They are like weathercocks, they show how the wind is blowing, and that is about all.

There is not much hope in the future for railroad machinists, but it is comforting to note that there are other places where the best class of men may make headway, especially in the great and growing automobile industry. In the Ford works, at Detroit, the minimum wages of skilled mechanics is fixed at five dollars per day. This is nearly twice as much as the railroad mechanic is paid, and the work is much lighter and cleaner, and the growth of the industry is much more rapid, and many of the best mechanics are turning their eyes in that direction.

It must also be remembered that while there are marked improvements in the condition of the railroad shops, especially in the modern buildings, there are many shops and roundhouses where the conditions are such that one would be as comfortable in the open air, in fact, much difficult work is actually done in the open air, and during the recent weather the amount of suffering among railroad machinists and roundhouse men generally was something great. If the press generally would follow your excellent example and give the matter due publicity, better days would be in store for the overworked, poorly paid railroad machinists and others.

E. W. Thomson.
West Albany, N. Y.

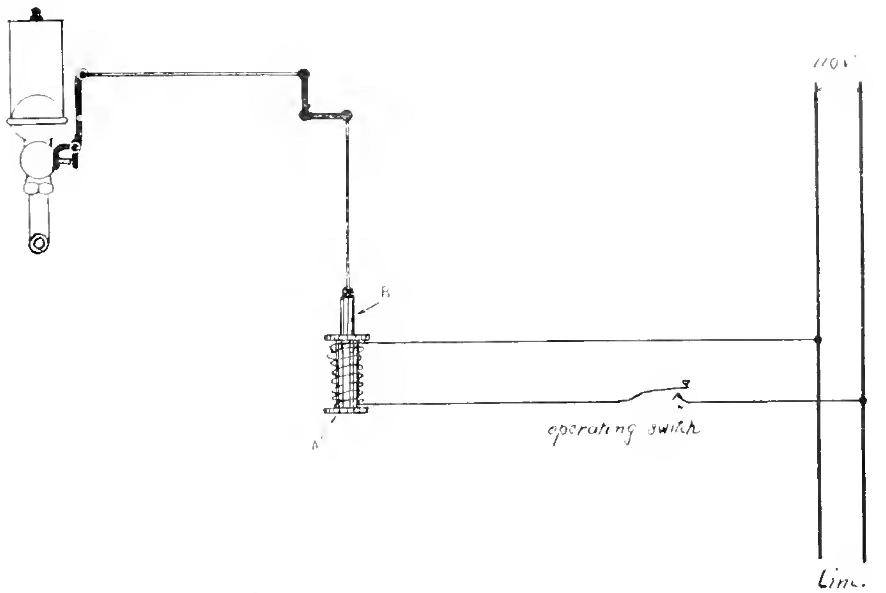
An Old Locomotive.

By Hugh G. Boutell.

How many people stop to wonder about the past of a locomotive which perhaps has taken them to their home in the evening, after the work of the day is over, and is as necessary to their comfort as that very home itself? So often as you are walking with a friend through any of our older cities you will point to an old residence, now in a poor part of the town, but still retaining some of its former splendor, and say, "Look at that place over there. That was a fine old mansion at one time. What a lot that old house could tell if it could speak." But how often do we ever apply the same line of thought to the old engine which hauls our local train?

To my mind there always has been something intensely interesting about an old locomotive; something that a brand new engine does not possess at all. It is the feeling of respect that we all have when we see an old soldier, one of the few survivors of the heroes who saved the Union for us fifty years ago. As one is bound to think of the battles which that man has been through, of the marches which he has made and of the work he accomplished, so I always think of the runs that old engine has taken, of the trains she has hauled and of the wrecks she has perhaps been in. I can see the day when at the head of the Limited she stood beneath the old train shed (now gone itself), ready to start on the fastest run on the road, a run which she took three hours to make where two are taken now. I can see the reflection of the summer sun on her cylinder heads, bell, rods and running gear, where now the cold light of winter only reveals a dusty black, with perhaps a little too much grease scattered around. I can call up that later day, too, when Andrews forgot for a moment about Extra one hundred and eight, and they came together head-on on the curve beyond the long tunnel. In time she was back on the road again, but the Limited never knew her again.

She has done her work well, and no one can do more than that, and as I linger awhile on the platform and listen to her story told in the soft breathing of the old air pump, I imagine that she is glad to have found a ready listener to some of her experiences.



ELECTRIC APPLIANCE FOR TIME WHISTLE.

Electric Time Whistle.

BY J. C. KOPPELL, MONTREAL.

In the operation for steam whistles for morning, noon and night hours on railway roundhouses, it is usually done from the boiler room, the engineer employing some means for signaling the fireman at the right time to blow the whistle. In our roundhouse we connected an incandescent lamp in all day's circuit. The lamp was put up in some prominent place where it was visible to all, and the switch was located on the punch clock, and the timekeeper watched the clock so that when the right moment came he cut in the lamp, and the fireman watching for the lamp blew the whistle.

But quite frequently it happened that the fireman was doing something on the coal bin or the feed pumps and forgot all about it, and consequently we had sometimes a late blast of the whistle. Finally, our clever electricians took up the matter, and the results of their ingenuity are shown in the annexed drawing. A is a brass appliance arranged to take the layers, ninety turns per layer, of number 13, magnet wire. The same switch is used on the punch clock, so that the timekeeper at the proper time cuts in the switch of the current coil. Then the armature B, becomes energized from the magnetic coil, and at the same time pulls downward and operates a crank which opens the whistle valve.

Device for Cleaning and Repairing Distributing and Plain Triple Valves.

By W. S. Everly.

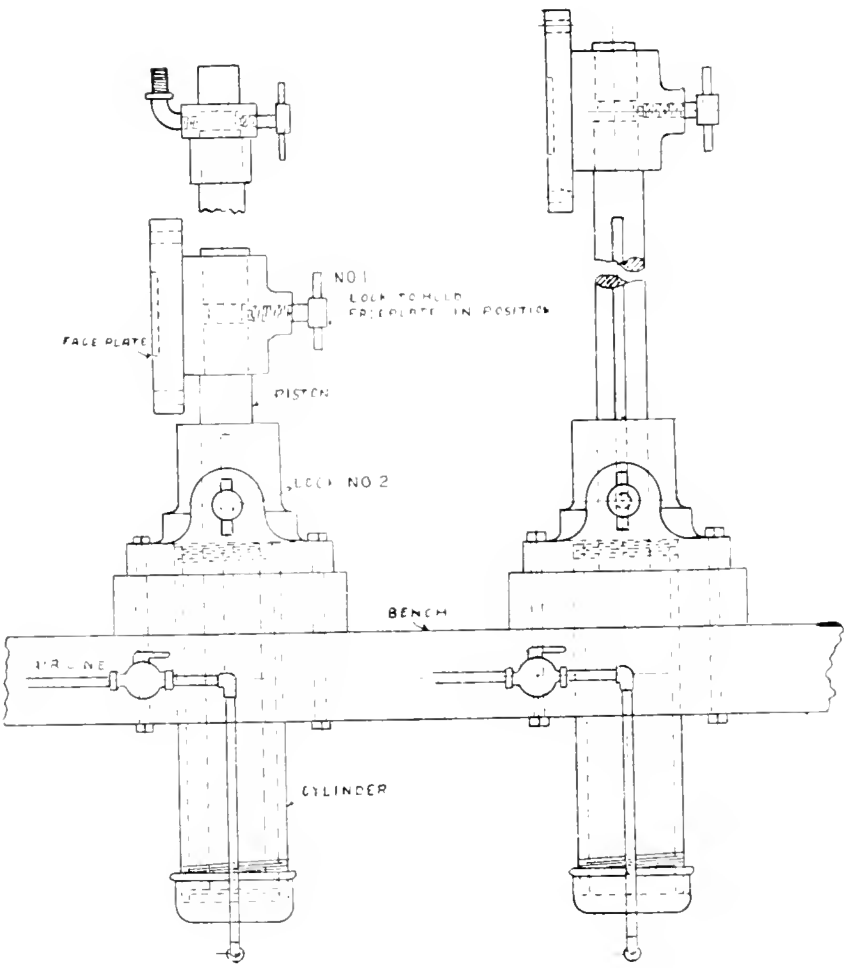
B. & O. R. R. Mt. Clare Shops, Baltimore, Md.

Enclosed you will find print of device built by me for cleaning and repairing distributing and plain triple valves. This device I have in use for some time, and find it a great time saver as well as very convenient for the repairman in making repairs.

The operation of this device is as follows: The distributing valve is bolted to the face plate by two stud bolts screwed in plate. After distributing rake has been applied, lock screw on the back of face plate is unlocked and valve can be revolved to any position convenient to the repairman; for instance, it should be placed so that the application rake chamber capscrews are right beneath the repairman's view; after this has been removed the face plate screw can again be unlocked and valve turned so as to

remove the application cylinder cap, application piston and exhaust valve. After this has been completed, the valve can again be revolved so as to remove the cap-nut on the opposite side of the application piston cylinder; this makes the upper portion of the distributing valve ready to be properly cleaned and repaired.

To care for the automatic or lower sections of the distributing valve the same as the upper section, as explained above, it is only necessary for the repairman to unlock the screw shown in the lower section of print below the face plate; this screw controls the height to which the repairman might desire any portion of the valve to be adjusted to suit his convenience; for instance, if the repairman desired to refit the equalizing slide valve to its seat, the valve can be lowered or raised to the most convenient point to suit the height of the repairman, at the same time the valve can be revolved to any angle so that the repairman can get the best advantage to suit the ray of the light, which is so essential in making these repairs. The raising and lowering of this device is accomplished by unlocking the lower lockscrew, which interlocks pistons and opening ¼ inch two-way cock, as shown in air line at front of bench; this admits air under piston in cylinder, as shown in print, forcing the piston face plate and valve upward until valve has reached its proper height, when lockscrew is tightened up and ¼ inch cock closed, in which position the air from the cylinder escapes to the atmosphere through a small release port in cock, after which lock-screw holds piston and valve to the height desired. When it is desired to lower valve, all that is necessary is to unlock screw holding piston, and the valve will descend slowly on account of a sufficient cushion being set up to care for the weight of the valve, due to the small opening in the ¼-inch cock release port.



DEVICE USED IN REPAIRING DISTRIBUTING AND ENGINE TRIPLE VALVES

You will note in the upper part of print broken away shows special fitting in caring for repairs to plain triple valves. In conclusion will say that those who handle repairs to distributing valves will readily see the advantage that this device affords in handling this class of work. Not only so, but the opportunities of making a thoroughly good job is made possible by the use of the device herein described.

Mechanical Conventions of 1914.

BY J. W. TAYLOR, SECRETARY, KARPEN BUILDING, CHICAGO, ILL.

We have received from Secretary Taylor, of the Master Car Builders', and of the Railway Master Mechanics' Association, a circular relating to the June Convention, the principal part of which reads:

Place: Atlantic City, New Jersey, has been decided upon as the place for holding our Conventions in 1914.

The Master Car Builders' Convention will be held on Wednesday, Thursday and Friday, June 10, 11 and 12, and the Master Mechanics' Convention on Monday, Tuesday and Wednesday, June 15, 16 and 17, 1914.

The Malborough-Blenheim Hotel has been selected as the headquarters for both Conventions. The President, Executive Committee and Secretary will have offices there; accommodations will be furnished for meetings of the various committees.

A schedule of hotel rates may be obtained from Secretary Taylor, Karpen Building, Chicago.

Attention has been called to the fact that last year a considerable number of our members stopped at hotels not represented on the schedule and from whom the Hotel Men's Association received no financial assistance in carrying out its contract with our Committee on Arrangements. It is hoped that the hotels shown herein will be patronized in preference to any others.

It is suggested that you make application for your reservation at once and if you have any difficulty in securing same report to this office and I will immediately take the matter up and see that you are located.

The registration booth will be in the Entrance Hall of the Million-dollar Pier. In order that a correct record may be made of the members in attendance, it will be necessary to register once for each Convention. Please, therefore, go to the registration booth before attending either Convention, announce your name to the tellers, who will register your name and furnish you with badges for yourself and guests.

A new badge, to be used during the Convention, will be furnished when you register. The badges for the families and guests of members will be of a different design from last year, and should be procured as soon as possible after your arrival.

Model of American Type Locomotive.

BY JAMES T. HAISE, SPARKHILL, N. Y.

It is very pleasant to note in the pages of your valuable magazine that a great number of young mechanics are occupying a portion of their leisure time in the construction of models of locomotives. Enclosed is a photograph of a model of an

American locomotive that I made recently. It is complete in every way, and is run by alcohol for fuel. I also constructed about 200 feet of a track. I am in hopes of being able to build a bigger one next and am studying the chart of a Mikado type of locomotive recently published by you, and which is the best chart of a locomotive that I have ever seen.

MODEL OF AMERICAN TYPE LOCOMOTIVE

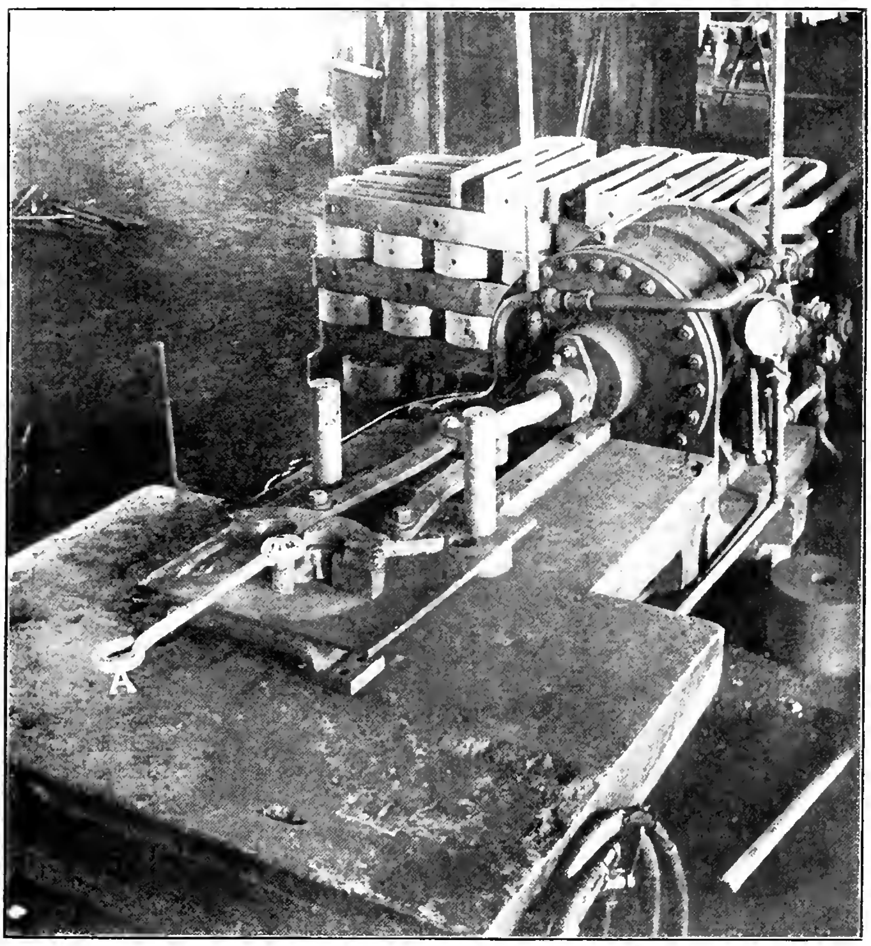
Brake Beam Hangers.

By H. A. Murray, Master Mechanic, Clifton Forge Shops, Virginia, Chesapeake & Ohio Railway.

The scientific management of railway shops is no more, or less, than the saving of unnecessary waste in time and material; or we might say, decrease the cost and increase the output. In order to show what is being done in this direction, I will describe the method in which brake beam hangers are being manufactured at the above named shops, at what we consider a very low cost (one and one-half cents each). The cost, however, does not include shearing the stock to length and handling the finished product to material bins.

The services of two men are employed: namely—a machine operator and a heater. The stock is cut to length to suit the length of hanger desired. It is then heated and bent in a "U" shape, as shown in operation number one. It is again heated to a sufficient length at points marked A A, and both eyes are then bent in an opposite direction. In other words, the hanger is completed with two heats and three operations. This work is accomplished on a machine shown in the accompanying illustrations. It was built in the shops at this point, and consists of a cast iron off-set slab plate, to which is securely fastened two air cylinders (one cylinder is only used in the manufacture of brake beam hangers, the other being underneath the slab plate and used for other purposes). The machine is equipped with a system of operating levers, which makes it very handy for the operator. The bending formers can be removed in an instant by simply lifting them off of the pins marked "B" "B." An air hose is also provided to remove the scale accumulation from the formers. The general make-up of the machine can be observed by referring to the above cuts, and while I have visited a good many of the railroad smith shops throughout the country, I think this machine equally as good, if not better, than any I have ever been able to see. I would consider it a valuable machine to have in any railroad shop, as it can be used to great advantage in manufacturing coupler yokes, etc.

The enormous low cost of the manufacture of brake beam hangers was made possible only by the manner in which our smith foreman, Mr. R. L. Woodrum, applied himself to the study of the subject of cost reduction and increased output, which should be the disposition of all foremen who are in the service of the railroad companies. I would like to say also that a statement has been made to the effect that brake beam hangers were made at the Cleveland shops of the Erie at a cost of five cents each, which in my opinion, is very high. The half-tone illustrations are intended to make clear to the reader the method used. They show the operation incorrectly as the eyes are formed last, as mentioned above.



MACHINE FOR CONSTRUCTING BRAKE BEAM HANGERS.

How Secret of India Rubber Was Discovered.

When a person hears the name Goodyear mentioned the association of India Rubber comes up as naturally as the name Westinghouse suggests the air brake. Few successful inventors have reached the climax of their ingenuity and perseverance without enduring hardships, but we think that the difficulties overcome by Charles Goodyear, of Massachusetts, who

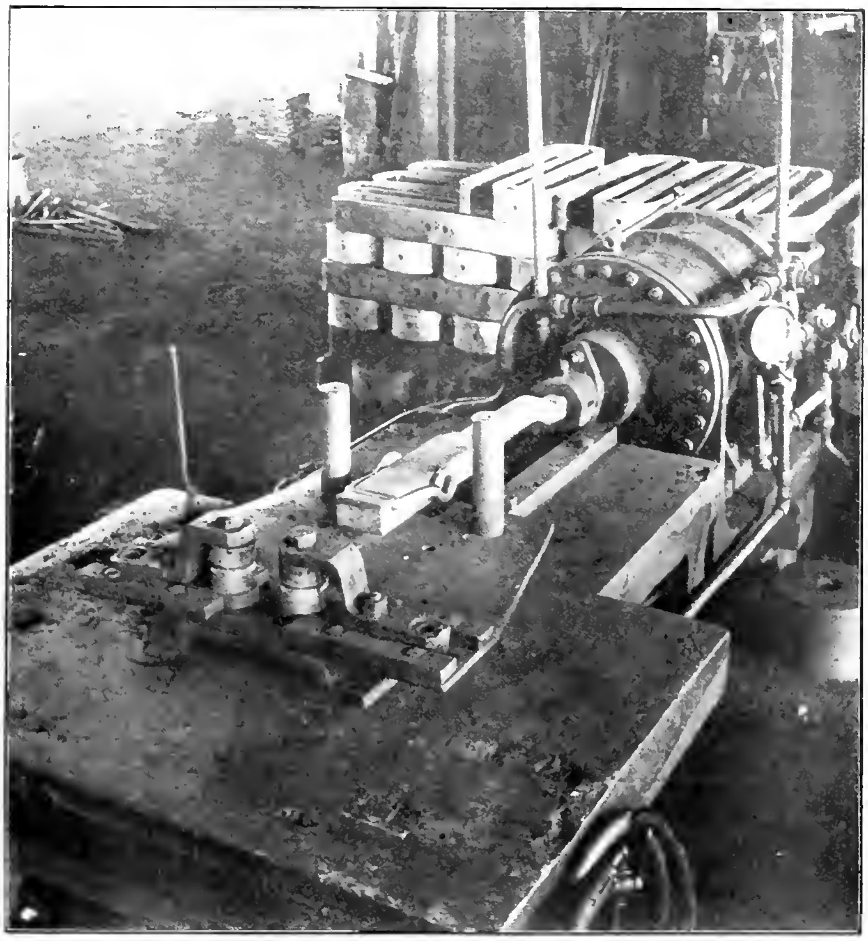
had made rubber of practical use about 1840, exceeds the perseverance of all other inventors.

The labor that culminated in the production of the rubber that has found so many uses in the industries of the world involved long, tedious experiments that would have discouraged most of men, but Mr. Goodyear was the kind of man who refuse to acknowledge defeat.

A sketch of the life of Charles Goodyear, which was prepared for the *Christian Science Monitor*, says:

His family was long dependent on the help of friends, or, as Mr. Goodyear himself was frank to declare, on actual charity. He records the gift of a barrel of flour at a time when he had walked 10 miles to ask financial succor for his home, where there was neither fire nor food. He tells of meeting a much dreaded creditor on the street and of his gratitude when a further loan was offered. He even collected and sold at auction his children's school books, which brought him $5 and enabled him to go on with his experiments. He was repeatedly thrown into prison for debt, and worked there with bench and tools to send money to his family. His wife wove and sold linen. Friends reproached him for neglecting his family while he went on and on and then still on with the experiments that seemed to lead nowhere. It was said of him in the town that if you were to meet a man all clothed in rubber, having even an India rubber purse without a penny in it, that was Charles Goodyear.

A glance at the portrait printed in George Iles' story of American invention, reveals, however, the idealism, the vision of the seer, that sustained Goodyear. He had been inclined to the ministry as a boy and faith never left him. It is to be noted that throughout the long struggle he had no encouragement from the work of other men. The gummy stuff that came from Brazil was like suet in hot weather and like iron in cold. The things Goodyear made were thrown back on his hands in a state of dissolution. The obstinate stuff stuck his workman fast to the bench when he thought he had overcome its stickiness. It was by a merely incidental act, apparently, that he discovered what nitric acid would do to the surface of the rubber, and then again through a dream of one of his assistants that the idea of sulphurization under solar heat came to him. After this he one day happened to touch a bit of the sulphurized rubber to the hot stove and to his astonishment saw that it charred instead of melted. This was the beginning of the end. Soon after we see him heating his rubber in his wife's oven till he knew how long to heat it. Step by step the thing goes on to the time when he finds that he can mix cotton fibers with rubber and make cloth.



MACHINE FOR CONSTRUCTING BRAKE BEAM HANGERS.

Shipbuilding on the Clyde.

We have been hearing much about depression in business lately and our shipbuilding has been far from prosperous, but a very different account comes from Glasgow, Scotland. An article in the *Glasgow Herald* says:

"As a shipbuilding center the Clyde still leads the world. In the year just ended it has far surpassed all its previous records of tonnage and horse-power. The year 1912 was the best ever then known on the Clyde, but the year 1913 shows an increase of nearly 20 per cent. on the work of the previous twelve months. The figures are astonishing. The Clyde yards have launched 374 vessels with a tonnage of 764,784 and an indicated horse-power of 1,117,490. Our twenty miles of river have produced more than a third of the whole tonnage built in the United Kingdom in 1912, and more than a fifth of the whole new tonnage of the world in that year.

"There are a few yards in England and Germany that are larger than any to be seen on the Clyde, but we have a greater number of large and busy yards than are to be found in any other part of the wold. The Clyde alone builds more ships than Germany, and probably twice as many ships, reckoned in tonnage, as America.

"We need only call attention to the central fact that the Clyde's great industry has, in the year now closing, become greater still. The yards have built every kind of vessel, from H.M.S. *Tiger* down to a destroyer, from the Cunard *Aquitania*, largest of British vessels, down to whole fleets of dredgers and launches, and customers have come from every part of the world. It is, however, important to note that a third of the vessels launched, representing 70 per cent. of the tonnage, were screw steamers, and that most of these are cargo tramps, the unpretentious carriers of the bulk of the world's commerce. The Clyde profits much by its numerous orders for warships, but these after all form only a small part of the Clyde's work. Our shipbuilders depend mainly on the commercial shipowners, and the industry is solidly based on the requirements of trade, not of war. There is nothing abnormal in the year's output. Though it is by far the largest yet recorded it represents the cumulative efforts of the two generations of enterprise skill, and hard work which have made the Clyde what it is."

The Great Western Railway Company has put in service two experimental, fireproof trains, each consisting of four cars.

Elements of Physical Science

By JAMES KENNEDY

INTRODUCTORY.

In resuming the publication of a series of articles on the Elements of Physical Science, it need hardly be stated that while there are a number of excellent works treating on the subject, many of them have not met with as much popular favor as they might have done had the matter been presented in a simpler form. The learned are largely given to showing off their learning, just as some millionaires exhibit their wealth. The popular mind does not take pleasantly to either. A long experience among railroad men has taught us that there is nothing to be gained by clothing the commonplace of their life work in scientific jargon. Clearness should be the aim, and the popular favor with which our efforts in this direction has been received is the best proof that our work has been appreciated.

While the sections published from month to month will be separate and complete, it will be of especial interest, and, we hope, benefit for our readers to begin with the beginning of the new series and follow the subject from month to month.

I. MATTER AND FORCE.

Matter is that substance which is perceived by the senses and occupies space, and may be said to be divided into substances of which earth, water and air are the chief varieties. All portions of matter of whatever size or structure are called bodies. The constant change of form in substances is caused by force, and whatever acts on a body producing a change in the form of that body, or a change in its relation to other bodies, is a force. Heat, electricity and light are thus called forces. All the phenomena in the material universe are produced by force.

Bodies are said to be solid when their particles have the quality of cohesion, and offer resistance to impressions or penetration by other bodies. A body is said to be liquid when the element of cohesion is so slight that the particles move freely around each other and offer little resistance to penetration by other bodies. Thus gases and vapors are said to be aeriform and have the quality of diffusion, but in a general way liquid and aeriform bodies are classified as fluids. It may be remarked that the same substance may appear under different circumstances in all of these forms. Thus water is a liquid, but when frozen it becomes ice and assumes a solid form, and when exposed to heat it is converted into steam, which is aeriform.

All bodies are distinguished either as simple or compound, simple bodies being those that cannot be resolved into more than one element. Compound bodies consist of matter that can be resolved into more than one element, as air or water, which are each composed of two gases. The simple bodies are being added to from time to time by reason of scientific discoveries. Among these about sixty are metallic bodies and are distinguished by a peculiar lustre. The remainder, less than twenty in number, are classified as non-metallic elements. It may be noted that the simple substances are extremely rare, nearly all substances in nature being compound, while some of the simple substances are so rare that their properties are not fully known, the compound bodies forming the vast bulk of the substances of the universe. The consideration of simple substances belongs to the science of chemistry. What is known as chemical affinity may be said to be the force that produces compound substances. This mysterious affinity exists only between certain substances. The science of natural philosophy treats of the properties and laws of matter, and, briefly stated, may be said to be a search for truth in the material world.

II. PROPERTIES OF MATTER.

Certain properties are inherent in every particle of matter. Some are common to all bodies, and are called universal properities of matter. Others are allied to certain substances only and are known as accessory properties.

The universal or general properties of matter are compressibility, divisibility, expansibility, extension, figure, gravitation, impenetrability, indestructibility, inertia, mobility and porosity. The chief accessory properties are adhesion, brittleness, cohesion, ductility, elasticity, hardness, malleability and tenacity.

Compressibility and expansibility are the opposite of each other, and both follow from porosity. The particles of bodies do not everywhere touch each other, and force will bring them closer together, as in the case of a sponge. If the pores are made larger, as is the case by heating some bodies, the size of the body is increased.

Divisibility is that quality which renders a body capable of being divided. It is claimed that there is practically no limit to the divisibility of matter. Small particles are called atoms, and a fine illustration of the divisibility of matter into atoms may be seen by dissolving a grain of copper in nitric acid and the atoms of copper will impart a blue color to a gallon of water.

Extension is that property of a body which has a certain size filling a portion of space. This portion is called its place, and is distinguished by dimensions embracing length, breadth and thickness. Figure is allied to extension, the form of solids being permanent, while that of fluids varies, adapting itself to every new surface with which it may come in contact.

Gravitation is a force inherent in all bodies by virtue of which they tend to draw every other body to themselves. Our planetary system presents to every enquiring mind an amazing illustration of this tremendous force.

Impenetrability is that quality whereby bodies occupy certain spaces to the exclusion of other bodies, and in virtue of which no two bodies can occupy the same space in the same time.

Indestructibility is that property which renders a body incapable of being destroyed. All matter is possessed of that remarkable quality, and while matter may assume new forms and even new properties, it cannot cease to exist. It may be noted in this connection that the apparent destructibility of matter as in the case of the evaporation of water is not in any sense a loss of water—it is merely a temporary changing of form, the water falling to the earth again as soon as the vapor is condensed.

Inertia is that property which renders bodies incapable of putting themselves in motion or coming to rest when in motion. The heavier a body is the greater is its inertia.

Mobility is that property which renders all bodies capable of being moved. All bodies also possess the quality of porosity in a greater or less degree. The porosity of water is best illustrated by heating the water, which causes expansion or a forcing of its particles farther apart from each other. Although the vessel is entirely filled with the heated water a quantity of salt or sugar can be slowly added without causing the water to overflow, showing that the salt or sugar finds a lodgment in the spaces between the atoms of water.

Of the accessory properties of bodies perhaps the most interesting is the varying tenacity of different substances. Experiments have shown that the breaking point of metals as tested on a transverse section of a square inch of a number of metals is as follows: Cast steel, 125,000 pounds; Swedish iron, 75,000 pounds; common iron, 55,000 pounds; cast iron, 19,000 pounds; cast copper, 19,000 pounds; cast tin, 4,800 pounds; cast lead, 1,800 pounds

Catechism of Railroad Operation

NEW SERIES.

First Year's Examination.

(Continued from page 20, January, 1914.)

Q. 86.—Do you consider it your duty and to your interest to study how the engine you are firing may be handled in such manner as will result in its performing the full service it is equal to without accident or delay at the lowest possible cost, as respects the fuel, oil and other supplies furnished for its maintenance and use in service?

A.—Yes, it is my duty to perform my duties in the most economical manner.

Q. 87.—Do you consider it to your interest to cheerfully comply with all the orders issued by your superiors?

A.—Yes.

Q. 88.—Do you realize that your service as a fireman is merely a period of apprenticeship for the position of locomotive engineer, and that it is necessary for you to familiarize yourself with all the parts of an engine, and the duties of an engineer, so that when needed you will be prepared for promotion and the successful performance of the duties of an engineer?

A.—Yes.

Q. 89.—Will you make a conscientious effort to learn the locomotives on this road and the modern methods pertaining to the successful and economical management of them?

A.—Yes.

Q. 90.—How can you best learn the latest and most modern methods in handling and care of the locomotive and its attachments?

A.—By studying the best books written on the locomotive and its attachments and studying the engine from what I learn in the books and by helping the engineer do his work on the engine while out on the road.

Q. 91.—Do you use intoxicating liquors or frequent places where it is sold?

A.—No.

Q. 92.—Name the different parts of the air brake on a locomotive?

A.—The air pump, discharge pipe, main reservoir, main reservoir pipe, automatic brake valve, independent brake valve, equalizing reservoir, feed valve, reducing valve, duplex air gauge number one, duplex air gauge number two, pump governor, distributing valve, reducing valve, brake pipe, double-heading cock, brake cylinders, brake cylinder pipe, brake cylinder cutout cocks, distributing valve supply pipe and cutout cock, non-return check valve with strainer, air signal pipe, reducing valve pipe, feed valve pipe, dead engine feature with cutout cock and non-return check valve and strainer, release pipe, application cylinder pipe, angle cocks and the necessary hose connections for the various pipes, and the pipe connections to governor, gauges and the equalizing reservoir, and the choke fittings in pipes to the equalizing reservoir, engine truck and tender brake cylinders, brake beams, brake heads, brake shoes or liners, brake levers and the rods connecting them.

Q. 93.—What is the air pump for?

A.—To compress air for use in the air-brake and air signal systems.

Q. 94.—What is the main reservoir for?

A.—To store the compressed air for use in the air system as it is compressed by the pump.

Q. 95.—Why are the main reservoirs on most locomotives in two parts?

A.—For convenience in storing a large volume of air without having the reservoir in the way, and to cool the air as much as possible before it passes into the air system.

Q. 96.—What other air brake parts are used on engines not equipped with the E. T. brake?

A.—An auxiliary reservoir and triple valve, with the necessary pipe connections.

Q. 97.—What does the triple valve do?

A.—It charges the auxiliary reservoir, applies and releases the brake.

Q. 98.—What is the auxiliary reservoir for?

A.—To carry a supply of air sufficient to apply the brake on the vehicle to which it is attached.

Q. 99.—Where is the air taken from that is used in the brake cylinders on engines equipped with the E. T. brake?

A.—It is passed from main reservoir into the brake cylinders by the distributing valve.

Q. 100.—What other type of brake is used on many locomotives, besides the automatic brake?

A.—The straight air brake.

Q. 101.—For what purpose is the cutout cock placed on a branch of the brake pipe in the back cab of the double cab locomotives?

A.—To be used by the fireman to stop the train, in case of emergency when it is impossible to communicate with the engineer, and a stop is necessary to avoid an accident.

Q. 102.—How should an engine be handled on the ash pit to avoid or prevent injury to the firebox and flues?

A.—The air pump throttle should be closed and the blower worked just enough to keep the gases from coming back out of door and the fire cleaned as quickly as possible, fresh fuel added and the door closed at once, the injector should not be worked while cleaning the fire nor until the fire is burning brightly again.

Q. 103.—Why should the air pump throttle be closed and the pump stopped while cleaning the fire?

A.—To avoid the forced draft which would draw cold air through the flues and to prevent cinders and dust from the ashes being drawn into the air cylinder of the pump, where it would do harm.

Q. 104.—Do you understand that the engineer is responsible for the work done by the fireman, and that the fireman is to be instructed by his engineer?

A.—Yes.

Q. 105.—In case of an emergency, such as a bursted flue or hole in the boiler which will let the water out, or failure of injectors and water becoming low, what should be done?

A.—The fire should be drawn or killed.

Q. 106.—How can you kill the fire quickly?

A.—By covering the stack, closing the dampers and door and putting the blower to work.

Note.—By covering the stack the draft will be stopped and no oxygen be drawn up through the fire. By putting the blower to work the gases in front end resulting from combustion will be forced back into the firebox where they will be deadly to the fire, for without oxygen there can be no fire.

Q. 107.—What is an injector? What is it used for?

A.—An injector is a device for forcing water into a steam boiler against a pressure greater than that which is affording the power. It is used to supply water to the boiler as it is needed.

Q. 108.—What two different kinds of injectors are used on locomotives?

A.—The non-lifting type which is placed below the water supply and has the water running into it from the force of gravity, or the natural tendency of a fluid to seek a lower level. The lifting type which is placed above the body of water and is so constructed that it raises the water up into it.

Q. 109.—What is a lubricator and its use?

A.—The lubricator is a device used to feed oil to the steam chests and the steam cylinders uniformly as it is needed.

Q. 110.—What should the fireman be sure to do after taking water each time?

A.—He should be sure to close the manhole to tank so that cinders and fine coal cannot get down into the water tank and perhaps stop the feed pipe to injector, or damage the injector itself.

Q. 111.—Why should the fireman accompany the engineer while he is making the inspection of engine, reporting the work needed, registering arrival and making out the time tickets for trip?

A.—Because he will learn the names of the parts of the engine during the inspection, learn how to properly report the necessary work, register his arrival in the proper manner, make out time ticket and delay reports as they should be, receiving the practical education necessary for his future vocation in life as a locomotive engineer.

Trainmen Working More Than Legal Limit.

There is considerable absurdity in the law which prohibits railroad companies from working trainmen more than sixteen continuous hours, but most of the companies affected try to obey the law although it causes much inconvenience in train operating.

The last Interstate Commerce Commission report tells that on 269 railroads, the chief railroads in the country, the aggregate number of reported instances in which employees in train service were on duty during the year for longer periods than sixteen consecutive hours was 261,332 cases, and of this number more than 79,000 were recorded by four railroads. This indicates loose details of management on the part of the railroads at fault.

An analysis is given of the primary contributing causes of delays responsible for excess service. From this analysis it appears that "derailments" have afforded the most prolific cause of excess service as to trainmen on duty more than sixteen consecutive hours, 88,317 cases being attributed by the carriers to that generic cause. In 33,360 instances the delays were due to coupler and drawbar defects, while 17,753 cases were attributable to miscellaneous car defects other than those affecting coupling mechanisms. Landslides, high water and fire were reported by the carriers involved as responsible for 17,985 cases, and congestion of traffic resulted in 13,812 employees exceeding the sixteen-hour period of service. In 10,620 instances the explanation offered by the carriers has been with reference to track defects and obstructions not resulting in collisions or derailments, while 9,910 cases were due primarily to collisions.

Under the heading of "engine delays," 15,507 instances of excess service were reported as attributable to miscellaneous mechanical defects, while other engine delays usually incident to the operation of trains were responsible for nearly 10,000 additional cases.

"It is believed that the carriers involved will concede to the commission's analysis of their respective reports such a degree of attention as will enable them, by apprising themselves of the preventable causes of excess service, to eliminate the majority of instances in which employees heretofore have been permitted or required to remain on duty for longer periods than sixteen consecutive hours, and it is confidently expected that the volume of such cases reported during the fiscal year ending June 30, 1914, will show a material reduction."

Petition on the Baltimore & Ohio.

Employes of the Baltimore & Ohio Railroad at Newark, Ohio, are circulating a petition to the Interstate Commerce Commission, asking that the application of the eastern railroads for an increase in freight rates be granted. The petition is being circulated in business circles, shippers, merchants, jobbers, buyers, public officials, professional men and others, showing a willingness to sign it. Several hundred names have been affixed to the document.

The petition is being circulated on the initiative of the railroad men themselves and has the endorsement of all classes of employes.

The communication to the Interstate Commerce Commission sets forth that the application of the railroads is believed to be wholly within reason, in view of the concessions made during recent years to employes, the higher cost of material and supplies and other items of expense having to be met. It also points out that both freight and passenger rates have been raised on foreign roads while during the same period in this country many of the rates have been reduced.

"The undersigned urgently solicit your favorable consideration of the request for an increase in freight rates," reads the petition, "in order that railroad facilities may be developed to meet the demands of constantly increasing traffic."

Stop Signal Control Safety Device.

A device designed to prevent a train from running past a block signal set against it was tested last month on the southern division of the Long Island Railroad, running from Jamaica to Far Rockaway. Present at the test were Thomas T. Chaloner, a chauffeur, the inventor of the device; E. M. Weaver, Chief Engineer of Maintenance of Way of the railroad; engineers from the New York, New Haven & Hartford, the Northern Pacific and other railroads, and two representatives of the Public Service Commission, besides several press representatives. All present expressed themselves as satisfied with the tests.

A special train made up of four cars was used. On the first trial the train was run at a speed of about thirty miles an hour. As it passed the signal a long metal arm connected with the air brake lever and extending through the roof of the last car came in contact with a cross piece of steel hung at the top of a supporting post. As the arm struck the cross piece the air brakes were automatically set, and the train stopped within 750 feet.

On the second trial the train was run at forty-five miles an hour, and was stopped within 900 feet. On the last trial the speed was between fifty and fifty-five miles an hour, and the train was stopped in about 1,200 feet.

The device is simple in construction and is not expensive to install. Its inventor claims that it cannot be affected by snow, ice or sleet, and will stop a train even if the engineer fails to observe a danger signal. It can be attached to any system of semaphores used on railroads of this country.

The general idea of the invention is not unlike the automatic tripping stop used in the subway, but it is overhead and may be used either on roads using steam locomotives or on those that have been electrified.

Measuring the Heat Sent Out by Stars.

At the last meeting of the Franklin Institute of Philadelphia, the subject presented for discussion was "The Heat Received by the Earth from Stars and Planets." In this lecture an account was given of experiments carried on at the Yerkes Observatory in the summer months of 1898 and 1900, directed toward detecting and, if possible, measuring the heat received from the stars Arcturus and Vega and the planets Jupiter and Saturn. The apparatus and the experimental methods and the results obtained were described and lantern slides shown.

It appears to us that scientists are falling very short of subjects worthy of investigation when they devote protracted energy to finding out the amount of heat transmitted by far away stars. No useful purpose could possibly be made of the knowledge obtained.

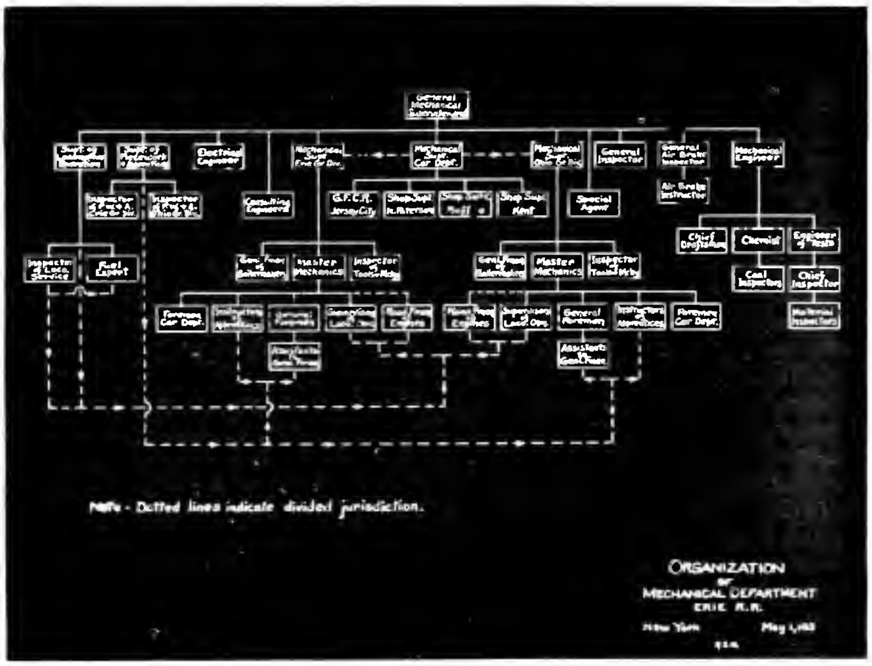
About 10 per cent. of the locomotive equipment on fairly prosperous railways is out of service undergoing repairs. About 2 per cent. of the repairs can be done in roundhouses, so there ought to be eight stalls in the back shop for every 100 locomotives belonging to the road.

The National Railway Appliances Association is sending out a series of bulletins regarding the exhibition in Chicago, March 16-20. These bulletins have already stirred up considerable interest.

General Foremen's Department

The Coming Convention.

Every effort is being made by officers and members of the General Foremen's Association to make the next convention, to be held in Chicago July 14, 15, 16, 17, 1914, the most successful in point of attendance ever held by this rapidly growing organization.



The superintendent of motive power and the master mechanic of today is looking to his general and shop foreman to work out the details of shop and roundhouse management in order that he may develop his talents along the lines of operation, which in the past has been handled exclusively by the transportation officials.

The mechanical railway official who does not take advantage of his position and inquire and keep posted on matters other than those of a mechanical nature, soon watches the procession pass him and sometimes wonders how it all happened. Consequently the general and shop foremen are taking over many of the shop duties and responsibilities formerly handled by superintendents of motive power and master mechanics. The best men in any line of business today are those who profit by the experience of others. Awkward, inefficient or ill-directed movements of men, however, leave nothing but wasted efforts.

The General Foremen's Association has within its membership the men who are continually on the firing line of mechanical progress. The papers read and discussed are worth many thousands of dollars to the railway company who sends able representatives to their meetings, and every superintendent of motive power and master mechanic should have in his possession a copy of the proceedings of the last general foremen's convention, and ask to have his name placed on the mailing list of the secretary in order that he may have mailed him a copy of the last and future proceedings of their conventions.

Note the subjects and send in your name for a copy.

Subjects for the 1913 convention:

1. Maintenance of the superheated locomotive.
2. Engine house efficiency.
3. Shop schedules.
4. Driving box work.

Subjects for the 1914 convention:

1. Engine house efficiency.
2. Cylinders, pistons, cross-heads, guides and valves.
3. The practice and methods of maintenance and repairs to the airbrake and its appurtenances.
4. Autogeneous welding.

Subsidiary papers:

1. The Taylor system.
2. Railroading at a high altitude.

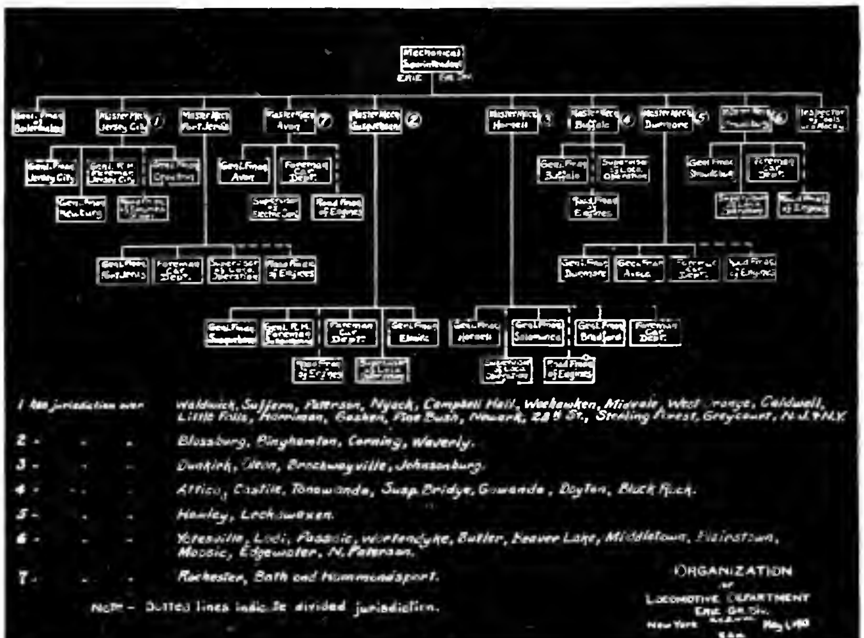
This latter paper is by J. W. Scott, locomotive superintendent Southern Railways of Peru, La Paz, Bolivia.

Mechanical Department Organization. Erie Railroad.

By R. S. Mounce.

During the past year, many changes have been made in the mechanical department organization of the Erie Railroad, and most of them have been in effect long enough to clearly indicate that they were wisely made. The four diagrams show the present organization as follows:

1. The entire mechanical department with the general mechanical superintendent at its head.



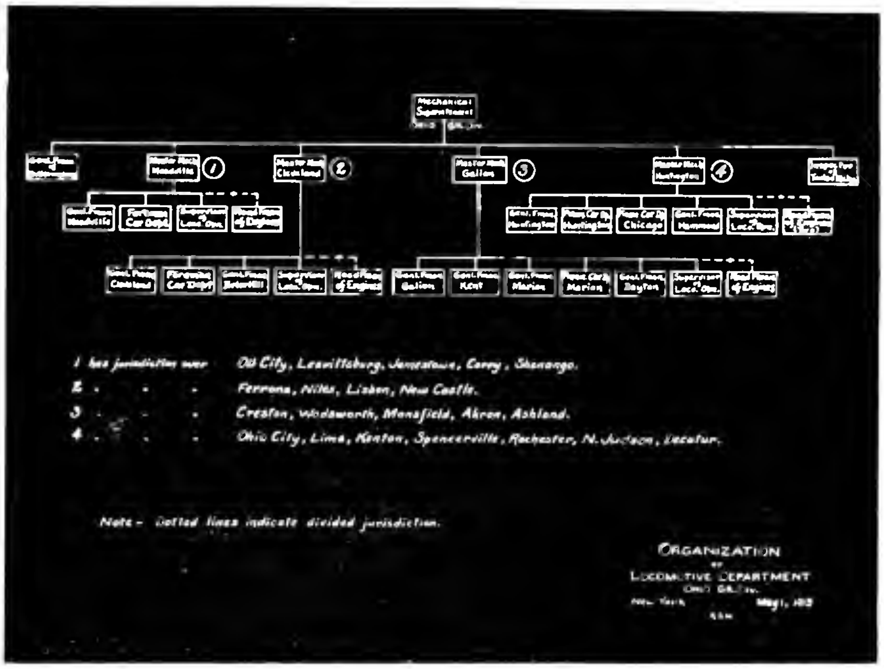
2-3. The two grand divisions of the locomotive department, each in charge of a mechanical superintendent, showing all division master mechanics.

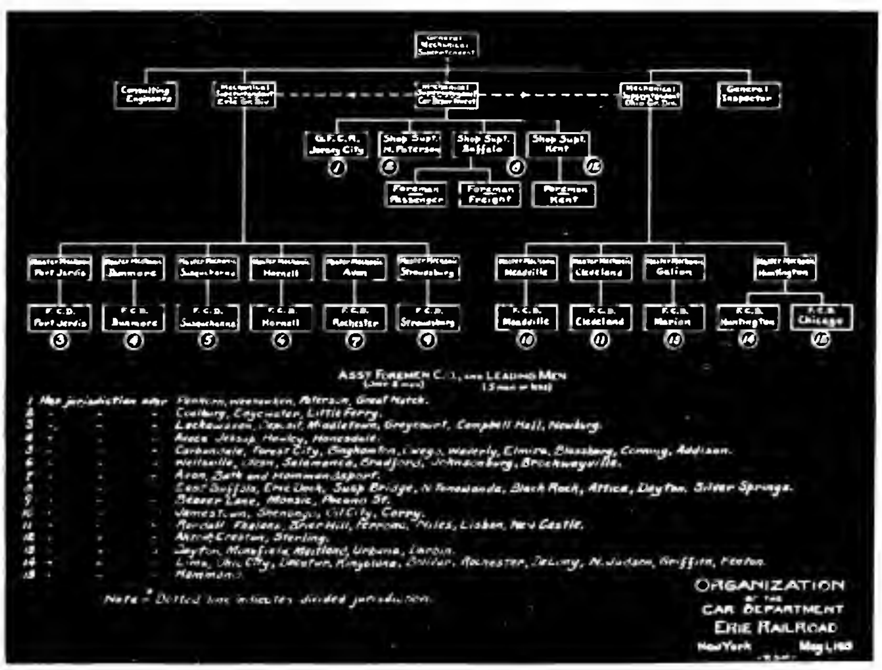
4. The car department in charge of a mechanical superintendent.

The following officers report directly to the general mechanical superintendent: Three mechanical superintendents, superintendent of locomotive operation, superintendent of piece-work and apprentices, mechanical engineer, electrical engineer, general air brake inspector, general inspector, consulting engineers, special agent.

The locomotive department is divided into two grand divisions, the Erie or eastern section and the Ohio or western section, each in charge of a mechanical superintendent, the first with headquarters at Jersey City, and the second at Cleveland. See diagram Nos. 2 and 3. Reporting to each mechanical superintendent are a general foreman of boilermakers, an inspector of tools and machinery, and the several division master mechanics. The first of these staff officers has jurisdiction over all matters pertaining to boiler work; and the second has to see that all tools are maintained according to the road's standards and he also has charge of the installation of machine tools, boilers and other such details. The duties of the master mechanics need no comment.

The car department with the third mechanical superintendent at its head is shown in detail on diagram No. 4. The mechanical superintendent, whose headquarters are at Meadville, has complete and direct jurisdiction over the three shops where all the heavy car repairs are made, namely; North Paterson (passenger car repairs), Kent and Buffalo (freight and passenger car repairs), each in charge of a shop superintendent, and also over the general foreman of car repairs at Jersey City, who has charge of all the terminal passenger car work and that at the outlying points in the commuter territory as well as the freight car work in this territory. The head of the department has charge of the minor car repair points through the heads of the locomotive department, or in other words, the foreman of the car department (F. C. D.) report directly to the master mechanics and, therefore, all instructions issued by the car department head are transmitted to them through the mechanical superintendents in charge of the locomotive department. This divided jurisdiction is shown by the dotted lines on the diagram.





The superintendent of locomotive operation has direct jurisdiction over the inspector of locomotive service and the fuel expert. The superintendent of locomotive operation and the inspector of locomotive service have indirect jurisdiction over the supervisors of locomotive operation and the road foremen of engines. The supervisors of locomotive operation report directly to the master mechanics and their duties are principally along the lines of fuel economy, lubrication, tools and other supplies. The road foremen of engines, who are essentially in the operating department, report to the master mechanics on matters relating to the maintenance of locomotives. The fuel expert reports to the inspector of locomotive service as well as to the superintendent of locomotive operation. The coal inspectors are under the jurisdiction of the chemist, who reports to the superintendent of locomotive operation on fuel matters. This constitutes the fuel economy organization and it closely connects the mechanical and operating departments, thereby insuring the best results through proper cooperation.

The superintendent of piece-work and apprentices has indirect jurisdiction over the assistants to the general foreman and the instructors of apprentices, who are on the master mechanics' staffs. The assistants to the general foreman look after the piece-work at the several shops and the instructors of apprentices are in charge of the technical and practical instruction of apprentices at the shops where schools have been established.

The mechanical engineer is located at Meadville. His staff includes the Chief draftsman, chemist, engineer of tests and all material and coal inspectors.

The electrical engineer looks after all electrical matters, including shop power installation and electric lighting of passenger train cars.

The duties of the general air brake inspector are fully explained by his title.

The general inspector has charge of all car department inspection and it is among his duties to see that all inspectors of new equipment are conversant with the stand-

ards and details called for by the specifications.

The consulting engineers are car experts and their duties are self evident.

The special agent is in charge of the details in connection with making improvements to insure safe working conditions at the several locomotive and car shops. He also keeps in touch with legislation concerning mechanical department matters, in order to make sure that the requirements are strictly adhered to.

Since this reorganization has been in effect, marked improvements in the efficiency of the department as a whole have been manifest, fully warranting the many changes that were made.

Questions Answered

Wear on Wheel Flanges.

F. A. R., Yreka, Cal., writes: We have two locomotives, one with three pairs of drivers, total weight about 50 tons, and one with two pairs of drivers, total weight about 39 tons. The former has 56-in. drivers, and the latter 63-in. drivers. The flanges are wearing sharp on the rear drivers of both locomotives, and we are unable to account for this as flange oilers are used on front drivers of both engines. Is there any way to remedy the trouble without turning down the drivers? If necessary to turn drivers, would we have to turn all of the drivers of both engines? A.—If there are trucks attached and the tracks are perfectly central, and the wedges working free in the boxes, it is evident that the rigid wheel base is too long for the curves on the road. Both engines require more lateral motion. This would rectify itself in time as the boxes and wheel hubs gather lost motion, which they soon do in the case of excessive flange friction. In case of turning the wheels, all of the wheels must be turned to the same diameter of tread. It may be added that in all locomotives the back outside wheel shears hard against the rails exerting an outward pressure. The exact amount of this pressure has not been fully determined. It would be interesting to attach a flange lubricator to the back wheels and mark the results.

Defective Car Heating.

F. B., Waterbury, Conn., asks:—If the steam heat gauge on engine registers the proper pressure and cars are not being heated properly, what is the best method of locating the trouble? A.—It being assumed that the steam-heat gauge is in good working condition, the best method of ascertaining the trouble is to go to the rear of the tender and examine the train pipe valve and see that it is wide open, as it should be, and that steam is being delivered to the coaches at that point. Then examine each coach separately from front to rear to see that the train pipe valves are in proper position. After the above course has been pursued and the trouble still continues the train pipes will likely be found clogged at some point. The particular coach having the defect may be located by examining each from front to rear of train, noting the first one operating unsatisfactorily.

Injector Troubles.

L. E. W., Brockwayville, Pa., writes: (1) Please explain why an injector will not work with hot feed water. (2) Two boilers of same capacity and working conditions, one carries 100 pounds steam pressure, the other 200 pounds; which requires the largest safety valve? A.—(1) An injector can only be operated by a vacuum being produced at the point where the steam and water meet. No approach to a vacuum can be effeced by water that is near the boiling point, as the heated water is readily vaporized. About 180 degrees is the point where the ordinary injector becomes ineffective. (2) On the assumption that the actual opening of the valve should be sufficient to discharge all of the steam generated by the boiler, the amount of pressure per square inch is a factor of little or no importance on the calculation. The area of safety valves is largely based on the area of grate surface and not on steam pressures. The best authorities differ somewhat; for example, the United States Supervisor's Rule being to divide the grate surface in square feet by 25 and the quotient will be the disk area of the safety valves. The English Board of Trade divides the grate surface in square feet by 2, and takes the quotient in square inches as the disk area of the safety valves.

Defective Brake Release.

R. Y., Macon, Ga., writes.—On a Pacific engine furnished with H-6 air-brake equipment, high speed pressures 110 and 130. Have no end of trouble with brake sticking and remaining stuck for miles after release of other brake. Hanging brake is almost always next to the last car or seventh from the engine. The train is an eight coach all-steel train. I get to full release one or two seconds, and then to running position with valve handle on final release. I go to running position for this final release but my experience is by not going at all to running position, I do not get brakes on train to release as quick for a start. In going to full release for a second mile final release the seventh car is overcharged. The brakes stick on it. I am at my wit's end to know why this occurs on the seventh car. Is this some defect with the car brake? Must I keep out and away from release and only go to running position? A. The time that the brake valve handle should be allowed to remain in release position when making a release of brakes depends upon a number of conditions which you have not described. The time of brake valve handle in release position when releasing brakes depends principally upon air pump and main reservoir capacity, type of car equipments in train, volume in brake pipe and auxiliaries and supplementary reservoirs if used, and the amount of brake pipe reduction made previous to the time of release. If you are not using full release position for over two seconds there is no danger of an overcharge, and especially not on the seventh or next last car.

Under conditions you mention this triple valve should be removed and tested before you change your style of manipulation, there may be a leaky triple piston packing ring in this valve that is causing your trouble. If you have a small pump or small main reservoirs you can stay in release position for a much longer time than 2 seconds without any danger of an overcharge, try 5 or 6 seconds if the triple valve is not found at fault.

Assuming that your brake equipment is all right, the cause of some rear brakes sticking may be due to making too light a brake pipe reduction, never make less than a ten or twelve pound reduction, if six pounds stops the train make the other five or six after you have stopped or before attempting to release.

In answer to your query, do not attempt to release brakes on eight long steel cars, with the valve in running position; you could not overcharge the train in two seconds, after a 12-pound reduction if you had six main reservoirs. We would further advise that the second movement to release position may be made with a long passenger train, in fact we think it is advisable, however, you should understand that the second movement to release should only produce a momentary flash of air from the main reservoir into the brake pipe to insure that the head brakes have an equal chance to rlease if the brake valve has been in release position for more than three seconds.

We are sure that you will appreciate the fact that it will be impossible to answer your question only in this general way, as you may be handling double equipments on eight cars with one 9½-inch pump and under this condition you could not expect anything else but occasional troubles from stuck brakes, but if you will try these suggestions and have the sticking triple valve tested and repaired, if necessary, your trouble will no doubt cease.

Brakes Sticking.

P. E., Jacksonville, Fla., writes.—I am hauling an 8 car all-steel passenger train, and am having trouble with brakes sticking, particularly on the seventh or next to last car. I stay in release position about

two seconds, then return to running position, but the brakes hang on for a time after leaving a station, am I overcharging the brake or is it due to defective equipment? A. If this trouble is only on the one car, the triple valve, and retaining valve and pipe, if used, should be tested and known to be in good condition before you change your method of release because if you are releasing the sixth and eighth cars without any difficulty the seventh, if not defective, should also release.

Not knowing the air pump and main reservoir capacity, or the type of car brake equipments in use, it would be impossible to state the time the handle should remain in release position, for any particular condition of release but as a general proposition, two seconds on an 8 car train will not overcharge the brakes no matter how large the main reservoir volume. The reapplication resulting from an overcharge takes place on the head rather than the rear end, and as you understand the importance of avoiding an overcharge, we would further suggest that to avoid, so far as possible, trouble from stuck brakes, never make less than a ten or twelve pound brake pipe reduction, that is total reduction before releasing. If a five pound reduction stops the train make another 6 or 7 pound reduction after the train has stopped, then make the release in the usual manner.

Primary and Secondary Batteries.

R. S. W., Chicago, writes: Explain what is the difference between a primary battery and a secondary battery. A.—In a primary battery the electric current is generated by chemicals in the cell itself; the secondary, or storage battery has the electrical energy from some outside source chemically stored in the battery, which becomes an independent source of current when the charging source is removed.

Ohm's Law.

A. J. M., Boston, writes: "What is Ohm's law? A.—Ohm's law is the law which governs the relation between volts, current and resistance in any direct current electric system. The formula is $C = \frac{E}{R}$ where C = electric current, E = the voltage and R = the resistance. If any two are known, the third can be easily obtained.

Pittsburgh's Enormous Use of Coal and Coke.

The Pittsburgh district of Pennsylvania is the largest consumer of fuel in the world, and in magnitude of coal traffic it is also pre-eminent. In population Pittsburgh ranks fifth among the cities of the United States, having as "Greater Pittsburgh" only about one-sixth that of Greater New York, but in the consumption of coal alone Pittsburgh nearly equals that of the largest city in the country. It is estimated (no accurate date available) that Greater New York consumes between 18,000,000 and 20,000,000 short tons of coal annually. The Pittsburgh district in 1912, according to Edward W. Parker, of the United States Geological Survey, consumed 17,721,783 tons of coal and about 5,000,000 tons of coke, or a total of about 22,700,000 short tons, over 10 per cent. more than all the boroughs of Greater New York. Moreover, Pittsburgh also consumes millions of cubic feet of natural gas. The total quantity of coal sent to New York harbor ports for local consumption, for bunker trade and for transshipment to coastwise and foreign ports is between 35,000,000 and 40,000,000 short tons. In 1912 the total coal business of the Pittsburgh district, including local consumption and shipment East and West, amounted to 59,150,179 short tons. The coke used and handled was approximately 14,009,000 tons, making a total of about 73,000,000 tons, or nearly twice as much as the coal going to New York harbor.

The quantity of coal shipped by rail and water to Pittsburgh and through Pittsburgh to points West in 1912 was 43,801,134 short tons, an increase of 4,160,226 tons over 1911. All of this increase was in rail shipments, as those by water fell off slightly, about 100,000 tons. The shipments to Pittsburgh were by rail, 7,778,450 tons, and by water, 9,943,333 tons. The shipments to points west of Pittsburgh were by rail, 24,086,001 tons, and by water, 1,993,350 tons. The shipments from the Pittsburgh district to Eastern points, all rail, which do not go through the city, amounted in 1912 to 15,349,045 tons, against 13,169,866 tons in 1911. The shipments of coke in 1912 were: to Pittsburgh, 4,962,207 tons; to points West, 5,684,566 tons, and from the Pittsburgh district to Eastern points, 3,294,656 tons.

Progress on the Quebec Bridge.

Work on the bridge across the St. Lawrence River near Quebec was carried on throughout the past summer and autumn. Practically all of the masonry work on the piers is completed, and progress has been made in the erection of the approaches, and of the steel falsework for the anchor spans. The steelwork is being fabricated in an entirely new shop at Lachine, Que., built especially for the Quebec bridge by the St. Lawrence Bridge Co., a newly organizel company holding the Quebec bridge contract. It has a capacity of about 2,000 tons a month.

All draughting, designing, etc., for the bridge is being done at Lachine by the St. Lawrence Bridge Co. under the direct supervision of the Board of Engineers, but when the shop designing is completed the whole office will be moved to or near the bridge site. When construction is started again in 1914, it is expected that erection will be prosecuted from both sides of the river and that the approaches will be completed by the end of next season. No estimate is made as to the time of completion of the anchor arms or of the entire bridge.

Permutite.

Permutite is aluminate-silicates of soda and potash. An analysis showed the composition to be as follows:

Silica	43.03%
Alumina	24.84%
Potash	3.19%
Soda	11.59%
Lime	.11%
Water	17.95%

The eliminating of scale-making material is accomplished by filtering the water through permutite. If the water contains carbonate of lime and sulphate of lime, permutite acts by taking up the lime and allowing the soda of the permutite to combine with the carbonic acid of the calcium carbonate and the sulphuric acid of the calcium sulphate, forming carbonate of soda and sulphate of soda; or in other wards, it is simply an exchange of bases as the water passes through the filter of permutite. The scale-making material of lime and magnesia coming out of the water, and the soda and potash going into solution. After a certain period, it is necessary to regenerate the permutite which is done by allowing same to remain in contact with a salt solution for several hours.

The magnesia salts are not as readily removed by permutite as lime salts (calcium). The advantage of the process is the complete softening of the water, the adaptability to work at low temperatures and for waters not having a constant degree of hardness. The water to be softened must be free from suspended matter and be neutral or slightly alkaline in reaction.

Looking for Work.

It is very difficult at present finding positions for men as general foremen, road foremen of engines or master mechanics. We have several excellent men on our list who would be highly efficient mechanical officials for any railroad in a position to hire them. For instance, we have one whose record reads: apprentice machinist four years, fireman three years, locomotive engineer two years, mechanical foreman five years, general foreman two years, master mechanic three years. Went into outside business and wasted accumulated substance. Ready to begin again.

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Proportions of Cylinders and Heating Surface.

There are certain requirements which must be made in the designing of a locomotive boiler that are frequently ignored, with the result that trouble ensues. Our national tendency to take a near cut to the desired goal, to make inferior to the best do the work, to find some royal road to learning that shirks labor are very dangerous tendencies when permitted to dominate boiler designing.

The chief requirements of a boiler are that it should be amply strong in all its parts to withstand the pressure to which it will be subjected; that it should provide an abundant supply of steam for the engine to be operated; that it should do the steam making with the least possible expenditure of fuel; that it should be of such design as to admit of repairing easily; and that it should not be subject to internal strains likely to shorten the period of its usefulness. In a general way these requirements have been adhered to, but great departures have been indulged in principally with the expectation of producing improvements. As one of the most important subjects to be reported upon and discussed at the next Railway Master Mechanics' Convention will be Design, Construction and Inspection of Locomotive Boilers, we think it will be reasonable to discuss some phases of modern locomotive boiler construction.

For years the proportion of heating surface to grate area of locomotive boilers was kept fairly uniform, but after a time it was discovered that the heating surface of a firebox was much more effectual than the heating surface of tubes, and a movement began to increase the firebox area at the expense of the tubes. From an engineering standpoint this was a mistake, but it was persisted in till in some cases the firebox evaporated a large amount of the steam used by the cylinders. The fallacy went so far that in 1897 a report was submitted to the Railway Master Mechanics' Association on The Proper Ratio of Heating Surface and Grate Area to Cylinder Volume, which did much to bring back designers of locomotive boilers to sound principles. A few years after that report was made public, the writer prepared an article on Proportion of Cylinders, Grate Area and Heating Surface, which reads:

"Taking the piston displacement, or the space swept through by the piston at each stroke of cylinder in cubic feet as a starting point, and dividing it into the number of square feet of grate area of a large number of highly successful soft coal-burning engines having cylinders ranging from 17 to 21 ins. diameter, I have found the average result to be six, that is to say, the piston displacement of one cylinder in cubic feet, multiplied by six, gives the grate area of the boiler. For example, take an engine having 19 x 24-in. cylinders. The piston displacement of one of these is 3.93 cu. ft.; multiplying these figures by 6 gives 23.58 sq. ft. as the grate area required, which agrees quite closely with the best modern practice. After deciding what area of grate is necessary, the length and width may be readily found, and if the former is so long as to be prohibitive of a box between the axles, then the box must go over the back axle or axles, and either between or on top of the engine frames, as may be deemed most desirable. The amount of heating surface, both flue and firebox, may be obtained in a similar way. Taking as before a large number of engines now running, and dividing the piston displacement into the number of square feet or firebox and flue heating surface, the result in the case of the former is 36 and of the latter 370. Taking the 19 x 24-in. engine again as an example, and multiplying its displacement, 3.93 by 36, we find that 141½ sq. ft. of firebox heating surface is required, and 3.93 x 370 equals 1,454 sq. ft. of flue surface required. The design of the engine determines how long the flues shall be, and when once this dimension and the diameter of the flues to be used are settled upon, it is an easy matter to find out how many flues you will need in the boiler."

In trying to make a comparison of the above calculations with the dimensions of a modern locomotive, we find that the increase of dimensions has gone on so rapidly that the lowest cylinder dimension we can find is 20 x 28 ins. in a Mikado type locomotive. The displacement of one of these cylinders is 5 cu. ft. When this figure is multiplied by 6, 30 is the result, which ought to be the size of grate area, but we find the real grate area of the engine to be 41.3 sq. ft. Following the system of calculations in the above example, to find the firebox surface we multiply the piston displacement by 36, giving 36 × 5 = 180 sq. ft. To figure out the flue surface required we have 5 × 370 = 1,850 sq. ft. Modern practice has reached away beyond these figures, for in the actual engine the firebox has 158 sq. ft. of heating surface, while the area of the tubes is 3,008 sq. ft. These figures would indicate that the craze for huge fireboxes is no longer moving designers. A variety of other locomotives examined indicate that the figures given are a fair example of modern practice.

Abusing the Sleeping Car.

Canon Hannay, who seems to be a very small-bone English churchman, has been assailing the American sleeping car. This ass of a divine rushes into print, saying:

"He and, what is more amazing, she will undress and dress again in these berths, which are like large coffins, with nothing between them and their fellow passengers except a curtain. I do not know how the thing is done. I cannot get my trousers either off or on when I am lying on my side with no chance of sitting up. The American man can and does.

"I shrink from attempting to imagine what happens to the American lady in a Pullman sleeping car. She does not, as a rule, protrude a leg through the opening of her curtains; but she does, I am told, get her stockings off."

When people first begin using sleeping cars they experience much inconvenience in dressing and undressing, but very little practice overcomes most of the difficulties. A railway car does not lend itself to luxurious bedroom suites; but the designers of sleeping cars have displayed extraordinary ingenuity in making the best of the room at their disposal, and deserve praise rather than blame for their performance.

The writer has reposed in sleeping cars in all parts of the world and therefore knows whereof he speaks. The British sleeping car is more exclusive than the American, but it accommodates fewer persons to the cubic area of the car than American. The Continental sleeping car is much inferior in every way to that in operation in America. The question of sleeping car accommodation turns upon what the sleepers are willing to pay. If they want room and extreme exclusiveness, special cars are at their disposal. It is unfair to blame sleeping car companies for making the best of the space at their disposal to provide accommodation that can be purchased at a moderate price.

Drummers Object to Paying for Excess Baggage.

Thirty-five thousand business houses and 400,000 commercial travelers, represented by the National Baggage Committee, filed with the Interstate Commerce Commission in Washington last month a petition for a reduction by sixty-nine railroads of the rates at present exacted for transporting excess baggage. The Merchants' Association of New York is one of the organizations prominent in the formation of the committee and in the agitation for a reform which is held to have arguments in its favor of a similar character to those which compelled a reduction of express rates.

The railroads now carry for each passenger who buys a ticket 150 pounds of baggage without extra charge, assuming a liability of not more than $100 in case of loss. For more than 150 pounds they generally make an extra charge of one-sixth of the passenger rate for each 100 pounds of "excess," with a minimum charge of 25 cents. Some States compel an allowance of 200 pounds to each passenger, and Canada allows 300 pounds.

The charges made for excess baggage are by no means onerous, but as the drummers are all the time working up business which increases the volume of railroad freight, it would be wise for the transportation interests to lose a little on travelers' baggage.

Delaware & Hudson Strike.

The Delaware & Hudson Railroad Company went through one of the most sensational strikes last month known to railroad history.

Last June a long freight train, consisting of fifty cars, of which J. H. Lynch was engineer and F. A. Slade was conductor, ran for 3½ miles before it was discovered that one car had jumped the track and was running upon the ties. For this both engineer and conductor were dismissed. The night was dark and foggy.

The case was considered by the Co-operative General Committee of the five railroad brotherhoods belonging to the company. This committee concurred in the judgment of the Grand Lodge officers and decided to submit the case to the employees, who voted to strike, which took place January 20 and lasted one day.

The committee of employees decided that the accident was unavoidable, a decision in which every trainman accustomed to the movement of long trains on a dark, foggy night, will concur.

The attempt to settle the dispute was taken up vigorously by Commissioner Hangar of the Federal Board. The officials of the railroad intimated that they were willing to arbitrate the case, but the unions refused to agree. After strenuous effort with both sides, Commissioner Hanger ultimately prevailed upon the company to agree to the men's demands and the strike was ended without delay.

Suppressing Individual Enterprise.

Where employers of labor have made a scientific study of the lowest possible income on which a worker can live, it is amazing the small pay that will keep a person alive. That process was pushed so far among the hand loom weavers in Scotland at one time, that it took sixteen hours of daily toil for a man to earn a bare living mostly of oatmeal porridge. The employers were mostly earnest Christian men who starved their work people under the grim working of free competition.

Railway companies have never permitted the tyranny of competition to starve their employers, but there have been cases where on small railways the workers have been treated more penuriously than those engaged in other occupations. That the management of ordinary railways have preferred to permit the property to fall into the hands of a receiver rather than starve their help, has been highly creditable to railroad proprietors, but their policy has received no approval from the politicians and law makers of the United States.

In an address delivered by Mr. Alba B. Johnson, of the Baldwin Locomotive Works, at the annual dinner of the New England Society of Pennsylvania the treatment our politicians are inclined to accord to accumulated capital and individual efforts is strikingly illustrated. Speaking of immigrants, he said, we need these people to hew our wood and draw our water. We need their aid in developing our resources and in operating our industries. Any legislation tending to exclude them for other reason than physical or moral incapacity is contrary to our interests. From the beginning of our history manly independence, thrift, a willingness to give and take, to view matters in a broad and generous spirit have been the characteristics of our people. They have believed that that government is best which interferes least with individual discretion. They have been content with the opportunity to work out the problems of personal business each in his own way, confident not only of self-rectitude, but of the rectitude of others. Have the time-honored traditions, ideals and aspirations of our country been abandoned and new ones substituted?

It is apparent that a new principle has come with the spirit of our Government—that men shall be made honest by statute rather than by the individual conscience. The tacit principle underlying both legislation and administration is that the aims and acts of individuals are evil, and that goodness and wisdom are to be found only in representatives chosen by the masses.

It is a principle as old as civilization that that government is strong which is composed of strong men. In feudal days that nation was strongest which held the most powerful feudal lords. In modern days that nation is strongest in its own resources and in the contest for the world's trade, which has within it the strongest business units. We are reversing that principle by insisting that, so far as it is in the power of government to do it, the business interest upon which our greatness as a nation rests, shall be made small and weak; that whatever individual or whatever corporation is permitted to prosper it will inevitably do evil to the community. It is not considered sufficient to control the misuse of power when it occurs, but we must go further and forbid the possession of power. That which other nations are striving to create we are bent upon destroying. Efficiency as a theory is extolled, but efficiency leads to success. Success is offensive to the spirit of the times and is therefore condemned.

Patenting Combination.

In connection with the discussion of a paper recently presented to one of the railroad clubs we hear considerable talk about inventions and devices that are not patentable. The talkers spoke of appliances being as old as the hills, therefore being beyond the range of patent protection. To people cherishing such ideas we recommend a careful study of the *Patent Office Gazette*. They will then find many cases of old devices being patented as combinations with other inventions.

Dealing with the infringement, there can be no doubt that a man who makes an invention consisting of a combination is entitled to restrain not merely persons who take the whole combination, but also others who take certain parts, and for the omitted parts substitute mechanical equivalents. A patentee need not, in his specification, claim mechanical equivalents expressly. Accuracy in claims is greatly

to be desired, in fact it is impossible to bestow too much care or attention on claims, but no amount of accuracy will be able to cover the inventive genius of the infringer. The inventor states how to carry out his invention. The infringer usually has another mode of doing the same thing. Moreover, a claim for a combination cannot do much more than claim the combination. A claim can direct the attention of the public to the features of the invention; but it is no province of the claim to describe the parts or their action. This belongs to the specification; hence it is a well recognized rule, when dealing with claims for combinations, to make reference to the specification itself to ascertain what the invention is.

Air Brake Convention.

The twenty-first annual convention of the Air Brake Association will be held at Detroit, Michigan, and the Hotel Pontchartrain has been selected as the convention headquarters.

The meeting will be called to order at 9.30 a. m., Tuesday, May 5, and continue through four days ending Friday, May 8. The Pullman Company will, as usual, extend to bona fide railroad employees, also dependent members of their families, the courtesy of half-fare rates in their cars to and from the convention.

At a later date we will print the titles of papers to be presented at this meeting, and the business to be transacted. It is certain that these papers will be up to the standard of previous meetings. Two interesting subjects to be presented are, mountain grade work and modern train building, the clasp type of foundation brake gear and the electro-pneumatic signal system for passenger trains will be discussed while Mr. Turner will present a paper of his own choice.

The usual good attention will be given to the entertainment of the members and their ladies, and one afternoon to be selected, will be set aside for the members to assemble in the hall, where each exhibitor of mechanical devices will be given from fifteen to thirty minutes time in which to exploit, by discourse, charts or lantern slides, or in any manner he chooses, the product or device he desires to place before the assemblage. The executive committee inaugurates this novelty, believing that it will assist the booth exhibits and give the members an orderly account of what the exhibitors are contributing to the air brake art.

To Stop Legal Killing.

The members of the International Safety & Sanitation Society make strong statements about things they want to change and which they are determined to abolish. At a recent meeting of this organization some keynote statements were made, among them such gems as:

"War is no worse than running a railroad."

"Automobiles and trucks kill more people in New York City every year than are killed in an ordinary South American revolution, and yet we become most excited over the latter!"

"Mechanical safeguards in factories cannot be made effective without the education of the individual worker."

"Mere fear of danger to himself will not prevent a workman from taking chances."

"We jeer at the French system of arresting the man run over in the streets; but that would be a good idea for practice here. If we made people use regular crossings and stopped 'cut-a-cornering' there would be fewer accidents."

"In the dark ages men killed each other to live; we do the same thing today, only in a different way."

On behalf of Mayor Kline, Borough President McAneny pledged his efforts to assisting the museum, should application be made by that institution for municipal aid.

Don C. Seitz assumed a pessimistic view of affairs, affirming that "human sacrifices still are offered, though the form has been changed." He pointed out that the average loss of life in American coal mines is 4.15 per cent. of those employed, while in Europe the average has been reduced to 1.8 per cent. He added that 720 persons are killed annually in Manhattan by falling structures or materials, while during the first eleven months of this year 277 persons were killed by automobiles in the city's streets, or fifty-six more than last year's total.

People speaking at these meetings display no idea of when to stop. This conference safeguarded its members from long-winded addresses by flashing a green electric light on each speaker when his allotted time was within a minute of expiring, and flagging him finally at the expiration of that minute with a red light.

Private Banks.

Labor organizations have exercised immense influence in the passing of laws intended to promote and protect the interests of laboring people; but in one line they have been lamentably remiss. It goes without saying that many rogues are constantly doing their best to possess themselves of other people's property without having any just claim to the same. One of the easiest methods of swindling people is by means of private banks. All private banks are not swindling institutions, but such a large proportion of them are of that character, that it is the bounden duty of the various States to see that no private bank is permitted to operate without the systematic supervision of State officials.

Unfortunately it is mostly poor people, who can ill afford to lose their savings, that become victims of private bank swindling. Among the private bank operators are many Italians and other foreign swindlers, who work on their compatriots and make them believe that they will receive much higher interest on deposits than can be obtained elsewhere and they become easy dupes to the rogues. During the last year about a dozen private bankers, who operated in and about New York, departed for places unknown carrying the deposits along.

It is a pity that the people who accumulate small savings are not better informed about the Post Office Savings Banks. There their money would be perfectly safe and ready for delivery when wanted. We call upon our readers to shed light on this question among their less enlightened acquaintances.

Baggage Grievances.

Railroad companies are too accommodating with passengers who drag pieces of baggage into cars to the personal inconvenience of other passengers. The writer was a martyr to this habit lately. As we were sitting quietly reading the morning paper a rustic entered the car dragging two huge packages, one being nearly as big as an old-fashioned box car. He decided to share my seat. Gazing about, his eyes rested upon the baggage rack, which he determined to utilize for his undergrown box car. Seizing this in his stalwart arms he flung it upon the rack and rested from his exertion. The piece of baggage rested on its perch but a brief moment, then it came down with a crack, landing on my head and going partly through the window. The owner laughed when he saw my hat crushed over my eyes and regarded the incident as a huge joke, while the brakeman looked grave but said nothing.

Texas Wants Railroads.

The Bulletin of the Texas Business Men's Association says that "railroads are badly needed in Texas to develop our agricultural resources. We have 27,000,000 acres of land in cultivation out of a total area of 167,000,000 acres, and the larger part of our idle land is susceptible to a high degree of cultivation."

We are sorry for the sensible business men of Texas. They are suffering like the woman who killed the goose that laid the golden egg. Years ago railroad construction was carried on very vigorously in Texas, until a set of senseless demagogues secured control of the State Legislature and proceeded to enact anti-railroad laws. People did not incline to invest their money in a region where sentiment was against them, so railroad building languished.

Pacific Locomotives for the Chicago Great Western

The requirements of modern passenger service were clearly reflected in the locomotives built for this class of work during the year 1913. These engines were all, with but few exceptions, of the Pacific type, designed to use superheated steam, and carrying the heaviest wheel loads permitted by the physical condition of their respective roads. The Pacific type is steadily replacing the ten-wheeled in heavy work, and is proving quite as adaptable to either heavy passenger or fast freight service as did its predecessor.

During the month of December, 1913, the Baldwin Locomotive Works completed, for the Chicago Great Western Railroad, five Pacific type locomotives which are notable because of their general design and the details of their construction. These engines develop a tractive force of 38,700 pounds, and with 152,400 pounds on driving wheels the ratio of adhesion is very nearly 4. The cylinder volume is 15.9 cubic feet, and the total equivalent heating surface of the boiler is 4,293 square feet. There are thus provided 310 square feet of equivalent heating surface per cubic foot of cylinder volume; a liberal allowance, even for a fast passenger locomotive.

The boiler is of the extended wagon-top type, equipped with the Gaines locomotive furnace. In the present instance, the firebox has a deep sloping throat, and is placed entirely back of the driving-wheels. The length of the combustion chamber measured from the vertical face of the tube sheet to the front of the bridge-wall is 30 inches. This wall has a thickness of 10 inches, and it is carried on a steel casting which is supported by lugs formed in one piece with the mud ring. The lugs are lipped on the bottom, thus relieving the bolts of shear. Air is conducted to the top of the wall through five wrought iron pipes, each 3 inches in diameter, which are set vertically in the brick work. The air, as it leaves the pipes, is in a heated condition, and is deflected in a downward direction under a brick arch. This arch is supported on four water tubes, and extends backward a distance of approximately 40 inches from the top of the bridge-wall. A long flame way is thus provided for the gases before they enter the tubes.

The total inside length of the firebox is 126 inches, while the grate has a length of 96 inches, and presents a surface of 56 square feet. The firebox is supported on expansion plates at the front and back. The inside shell is radially stayed, and the front end of the crown is supported on two I-bars which are hung on expansion links. 351 flexible stays are placed in the breakage zones in the sides, throat and back head.

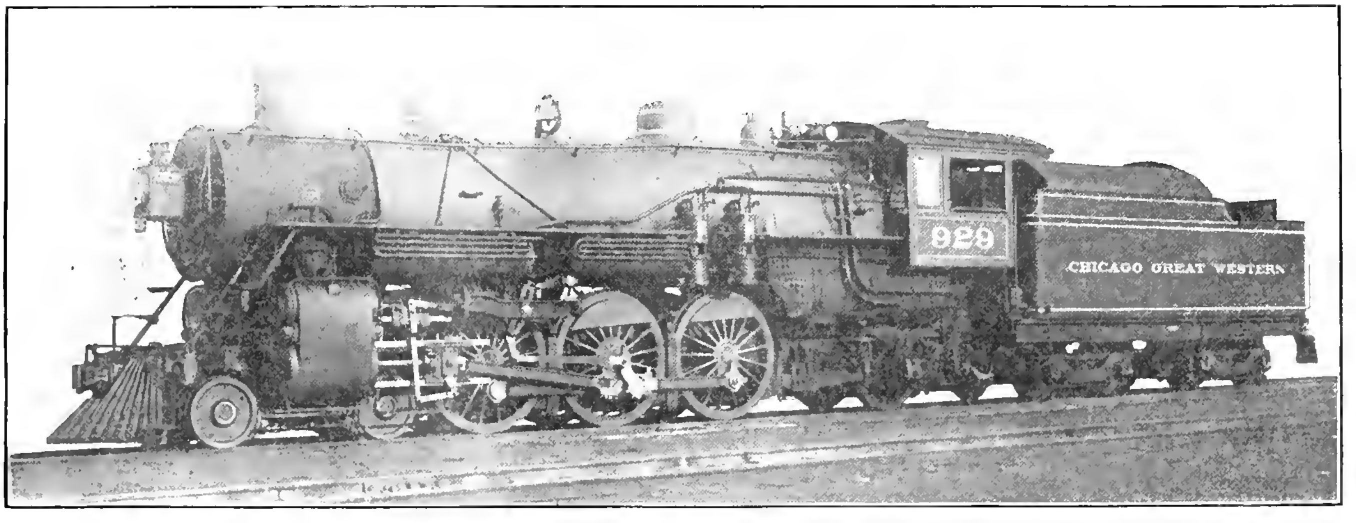
The main frames are vanadium steel castings, $4\frac{1}{2}$ inches in width. They are strongly braced at the front, main and rear driving pedestals; and the upper frame rails are also transversely braced by the guide yoke, valve motion bearer, and a broad steel casting placed between the main and rear drivers. The back pedestal brace is a large casting, which strengthens the frames at the splice between the main and rear sections, and also supports the expansion plate carrying the forward end of the mud ring and the radius-bar pin for the trailing truck. This truck is of the improved Hodges type, with spring-links arranged to swing in planes tangential to the arc in which the truck frame swings. No cross-beams are used in the truck equalization, and ample space is provided for a deep ashpan. This is of the two-hopper type with swing-bottoms.

The steam distribution is controlled by 15-inch piston valves, driven, by Walschaerts motion and set with a lead of 3/16-in. The cylinders are fitted with by-pass valves of the Sheedy pattern.

The details of these locomotives have, where practicable, been made to interchange with those of engines already in service. This is particularly true of the Class L-1 Mikado type locomotives built in 1912. The piston valves, crossheads, main driving boxes, pedestal shoes and wedges, driving springs, and spring saddles, are among the more important details that interchange in these two types.

The tender is fitted with a vestibule connection at the rear. The tender and the leading engine truck wheels are of solid rolled steel, manufactured by the Standard Steel Works Co.

These engines represent advanced practice, although they embody only such features as have been tried out in service, and found reliable. Efficiency is the keynote of the design, and there is every indication that the locomotives will prove successful.



PACIFIC, 4-6-2, TYPE LOCOMOTIVE FOR THE CHICAGO GREAT WESTERN RAILROAD.

G. M. Crownover, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Gauge, 4 ft. $8\frac{1}{2}$ ins.; cylinders, 25 x 28 ins.; valves, piston, 15 ins. diameter.

Boiler.—Type, Wagon-top; material, steel; diameter, 72 ins.; thickness of sheets, 11/16 and $\frac{3}{4}$-ins.; working pressure, 190 lbs.; fuel, soft coal; staying, radial.

Fire Box.—Material, steel; length, 126-1/16 ins.; width, $84\frac{1}{8}$ ins.; depth, front, 76 ins.; depth, back, 64 ins.; thickness of sheets, sides, 5/16-in.; back, 5/16-in.; crown, $\frac{3}{8}$-in.; tube, $\frac{5}{8}$-in.

Water Space.—Front, $4\frac{1}{2}$ ins.; sides, $4\frac{1}{2}$ ins.; back, $4\frac{1}{2}$ ins.

Tubes.—Material, steel; thickness, No. 9 W. G., No. 11 W. G.; number, 32, 239; diameter, $5\frac{3}{8}$ ins., 2 ins.; length, 20 ft. 6 ins., 20 ft. 6 ins.

Heating Surface.—Fire box, 225 sq. ft.;

tubes, 3,474 sq. ft.; firebrick tubes, 33 sq. ft.; total, 3,732 sq. ft.; grate area, 56 sq. ft.

Driving Wheels.—Diameter, outside, 73 ins.; center, 66 ins.; journals, main, 11 x 12 ins.; others, 9 x 12 ins.

Engine Truck Wheels.—Diameter, front, 33 ins.; journals, 6 x 10 ins.; diameter, back, 52 ins.; journals, 8 x 14 ins.

Wheel Base.—Driving, 13 ft. 0 ins.; rigid, 13 ft. 0 ins.; total engine, 35 ft. 4 ins.; total engine and tender, 66 ft. 0 ins.

Weight.—On driving wheels, 152,400 lbs.; on truck, front, 52,200 lbs.; on truck, back, 52,400 lbs.; total engine, 257,000 lbs.; total engine and tender, 410,000 lbs.

Tender.—Wheels, number, 8; diameter, 36 ins.; journals, 5½ x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 11 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 794 sq. ft.

*Gaines furnace grate, 96 ins. long.

Economical Firing from a Practical Standpoint.

Fuel economy has been given extensive consideration within the last few years, due to its increase in cost which is advancing annually.

The economical use of fuel on locomotives can only be obtained by the harmonious co-operation of the engineman, fireman and all concerned.

The interest and disposition shown by the engineman in charge will in time be noticed by all, and will have a great effect upon the outcome of the fireman when his time comes for advancement.

The fireman as an apprentice should show his desire for advancement by close observation, and should not be too proud to ask his engineman or any one whom he thinks may be able to give him advice on any question regarding his duties, that may not be clear to him.

The success of an engineman dates back from the first day he commenced as a fireman. Firemen should not put off getting ready for examination until they are notified, but start from the beginning and work to the end with utmost enthusiasm.

The economical use of fuel is one of the first and most important subjects to be taken into consideration. One of the first secrets in the economical use of fuel is to have the fire in first class condition before leaving the terminal or before the engine is required to do any hard work. Start building the fire sufficiently in advance of the leaving time so as to have a good live fire all over the grates; and particular pains should be taken to see that the back corners and sides as well as the back end of the firebox are well supplied, as the draft on the fire has a tendency to draw the fire from the back of the firebox toward the front end.

Good results have been obtained by shaking the grates a little just before starting out on a trip. In shaking the grates move the lever with short, quick jerks to loosen up the fire and break up any clinkers that may have commenced to form. Shaking the grates while an engine is working or especially while it is working hard has been found to be a very bad practice for this reason—while the engine is working hardest the circulation of air through the fire is most severe, and wherever the fire is the lightest on the grates the circulation is the greatest, and disturbing the fire by moving the grates has a tendency to assist the draft in lifting the fire off these light places and this results in holes in the fire. This will be noticed most should there be any clinkers in the fire or a bank, because whenever the draft is cut off from any one place of the grate surface it is thrown to some other part.

Firing coal in large lumps is also a bad practice and has the same effect as banking the fire. Banking the fire is considered impracticable and good results are not obtained. Whenever a bank is put in a fire or allowed to accumulate in a fire a clinker is almost sure to follow, and not only that but the heating surface and grate area are being decreasel and the temperature of the firebox lowered to a great extent.

The theory of some firemen is if an engine does not steam freely they should put a bank in the fire and still they can give no reason why they derive any benefits from this method. It stands to reason if an engine does not steam freely with a good, bright, level fire all over the grates that they will not help the cause in decreasing the heating surface by filling the firebox with green coal, thus lowering the temperature of the fire which is the reverse of that which they should do when the engine fails to hold up in steam.

In calculating and designing a locomotive boiler the size of the firebox is given great consideration on account of the steaming qualities of the boiler, but the lack of space is also a great factor, therefore it should be kept in mind that no unneccessary grate area is added, and to get best results the entire grate surface must be utilized to its highest efficiency.

The proper thickness to carry the fire can only be known by practical experience, it depending largely upon the way the engine is drafted, the way the engine is handled and the quality of the fuel.

The engineman should bear in mind that the way he handles the engine, especially in leaving the yard or terminal or any other starting point, has much to do with the condition of the fire. In case it does become necessary to work an engine extremely hard, it has the tendency to disarrange the fire and by opening the fire door two or three inches will relieve the fire of the excessive draft. In this way the fire can be kept in good condition until the working of the engine is again restored to normal condition.

Coal should not be supplied to the fire in large quantities. Even distributing of coal on the fire is one of the most important factors in economical and scientific firing. The least coal that is supplied to the fire at one time to necessarily maintain the highest degree of heat, and the more regular it is supplied the more even the temperature will be in the firebox, therefore it will be seen that best results can only be obtained by firing light and often. In this way there is less variation in steam pressure which is not only a great benefit in handling the engine economically, but also prolongs the life of the boiler and is a great preventative of leaky flues.

Manipulation of the injector in supplying the feed water is another important part of the engineman's duty, and plays a great part in fuel economy. Do not put a large quantity of water at any one time into the boiler when there is ample time to put it in by small installments. Do not work both injectors at the same time unless it is necessary to protect the crown sheet or stop popping. The injector should be worked as fine as possible so as to maintain an even water supply.

Try to keep the steam pressure up to as near the maximum working pressure at all times as possible and not have the pops open. The pop valves are applied to a boiler for safety only and a good fireman takes just as much pains to keep them closed as he does in trying to keep the steam pressure near the maximum point.

Many firemen who are not in the habit of swinging the door shut after each scoop of coal is fired, do not believe that there is any use in doing so. When the door is open the draft pulls the air through the door instead of the fire, therefore combustion in the firebox is lessened because there is very little, if any, circulation of air through the fire. During the time that the cutting action of the draft through the fire is stopped, any clinker-forming impurities, which are present in all coal, will have a chance to run together and form clinkers. Besides this the cold air drawn through the fire door when open will cause the flues to leak. The proper way to do is to swing the door shut after each scoop of coal, and the results obtained will be more than appreciated before the completion of the trip.

Knowledge of your business will insure your position and make your work easier. Do not act as if your position were only a job to get your living, but make it a trade, or better yet, a profession, and in the end promotion is almost always sure to come, not speaking of security and employment which is sometimes better than promotion.

Roy J. VanMeter, Engineman,
Chicago River & Indiana Railroad.
Fort Wayne, Ind.

Air Brake Department

Deposit of Moisture.

In past issues we have touched upon the subject of collecting moisture, and preventing it from entering the brake system, incidentally pointing out several well-known methods of main reservoir and piping installation. At the same time it was pointed out that the capacity of the atmosphere or compressed air to hold moisture varied directly with its temperature and inversely with its pressure, which is equivalent to saying that the higher the temperature of the compressed air, the greater its capacity for holding moisture in suspension, and temperature remaining constant, the higher the pressure the less amount of aqueous vapor that can be held in suspension.

Following those conclusions we find that water is never deposited in the air pump cylinders or in the discharge pipes, and frequently none can be found in the first main reservoir, and if the air passes through the brake valve at a higher temperature than that of the surrounding atmosphere, it will be holding some moisture in suspension that will be deposited in the brake pipe, where pressure will likely remain constant and the temperature reduce and the moisture will be what may be termed, "squeezed" out of the compression and deposited in the hose couplings or sags in the piping.

It is not necessary to say that this is undesirable in any kind of weather, and correct methods of piping and main reservoir location will prevent any serious trouble from water in the brake pipe provided that the compressors are in a reasonable state of efficiency, or if the temperature of the compressed air passing through the discharge pipe is not greatly in excess of the natural degree of heat generated during or incident to compression, the temperature can reasonably be expected to reduce sufficiently to deposit the moisture in a correct installation of main reservoirs and piping, from where it can be drained at stated intervals.

If, however, the compressor is what is usually termed running hot, and if the amount of compressed air being used taxes it to its capacity, there is very likely to be some water deposited in the brake pipes as well as in the various air brake valves and sanding devices on the locomotive.

The locomotive air compressors are not intended for continuous service, otherwise the air cylinders would have been water-jacketed, and if they are allowed to run continuously and for a considerable period of time, an overheated pump is sure to result. A lack of lubricant is synonymous with an overheated air pump, and an overheated pump is about as annoying and dangerous a defect as the air brake system is liable to have, in that its capacity is reduced anywhere from 50 per cent. to 75 per cent., and as it is necessary to keep the air cylinder oiled to prevent it from being entirely ruined, the burning oil and foreign matter are scattered throughout the brake system with a variety of results.

Practically all of the undesired quick action due to sticky brake valve equalizing pistons can be traced to a deposit of this burning substance on the equalizing piston, and the hard handling brake valve is nearly always due to the pump becoming overheated. The writer has made some observations in connection with oiling an overheated air pump, in one particular instance an 11-inch pump arrived at a terminal with the air cylinder considerably overheated due almost entirely or as near as could be determined, to a lack of lubrication as the pump had been in excellent condition the previous trip, and was in a high state of efficiency after being allowed to cool.

Upon the arrival of the engine at the terminal, a leak of about 10 pounds per minute was made in the brake pipe and the speed of the pump was reduced and the air cylinder given a liberal quantity of valve oil, enough to thoroughly lubricate the walls of the cylinder. The brake valve was apparently in good condition and the feed valve had been accurately repaired the day before, it showed a variation or fluctuation of about two pounds on the gauges before the pump was oiled.

The leakage remained constant, and within two minutes of the time of oiling, the brake pipe hands registered a fluctuation of 15 pounds, and within five minutes the feed valve operation ceased entirely, due to the supply valve piston sticking in the bushing. Incidentally it was noted that at this time it required a pull with both hands to move the brake valve handle, which was found to be due to a deposit of gummy moisture on the rotary valve and seat, the equalizing piston also received a considerable quantity of this foreign matter.

Many roads follow an excellent practice of removing air pumps from the locomotive for inspection and repairs at the end of three, four, or six months' service, which permits of maintaining the air cylinders in good condition and the ports and passages are kept clean. Where efforts are made to get all the service possible out of a pump before it is removed, it is only natural to expect overheated pumps, broken air valves and piston rods, and the waste of air pump material that is sure to follow in the wake of inefficient air pumps.

Under average conditions, if an air brake repairman or a number of repairmen in a shop are kept too busy on air pump, brake valve, triple valve and distributing valve repair work to enable them to change pumps at stated intervals, they will likely find that if they will make an experiment and neglect some of the brake valve and distributing valve work for a short time and use this spare time in changing air pumps, or, in other words, cease fighting the effect for a time and go to work on the cause, they will find that in about six or eight weeks' time the brake, signal whistle and air sander work will fall off about 50 or 75 per cent.

It is extremely difficult to impress upon those who must put up with the effect of an overheated pump, the importance of keeping the degree of heat generated to the lowest possible figure, the friction encountered in forcing the fine particles of air together during compression generates a high degree of heat that cannot be prevented, for with a pump in first-class condition and well lubricated, a test showing the normal heating resulting from extreme duty alone, demonstrates that a 9½ inch pump which for one hour maintained an average speed of 174 strokes or exhausts per minute, working constantly against 100 pounds air pressure, was discharging the air at a temperature of 408 degrees. Higher speed of greater air pressure would have increased the heating, while slower speed, shorter time of test or lower air pressure would have decreased it.

Speaking generally, the speed should not exceed 140 exhausts per minute, and such a speed should not be continuously maintained for any considerable time, as even this speed will cause excessive heating. This is shown in another test where an average speed

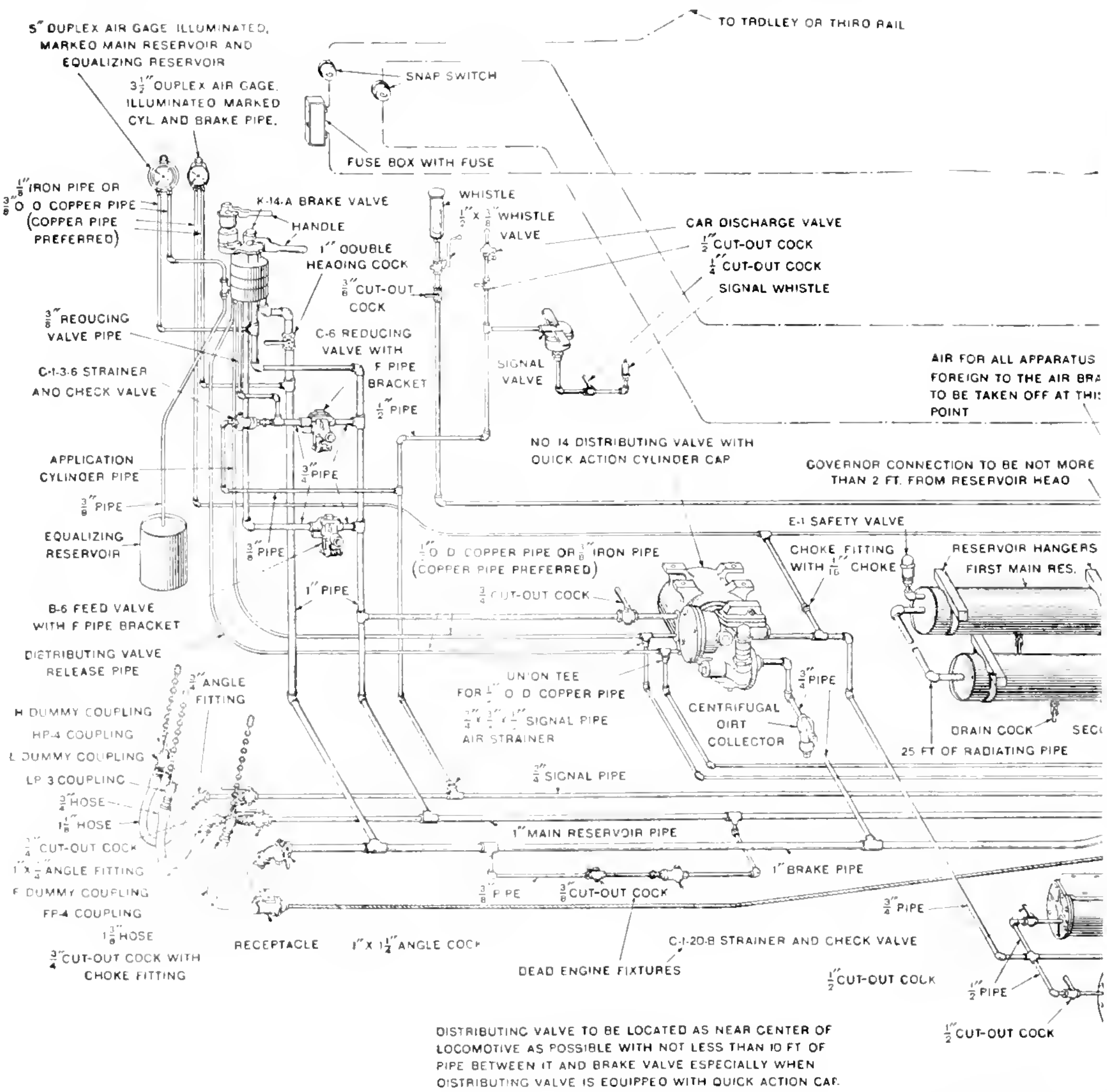
of about 60 exhausts per minute, after the main reservoir pressure was pumped up, and a maximum of 77 strokes per minute, at the completion of an hour and fifty minutes of the test, gave a discharge temperature of 316 degrees.

The foregoing shows plainly the need of good maintenance, of not wasting air either by leakage or poor handling and of giving the compressor as much time to do its work as is practicable.

of an overheated air cylinder, the only plausible or possible assistance that can be rendered, is to reduce the speed and keep the cylinder oiled until it regains a portion of its lost efficiency.

This is a very dangerous disorder where trains are controlled by air brakes on mountain grades, and while some of the evil effects have been noted, the heating and uneven cooling of the air cylinder frequently warp it to such an extent, that the pump never regains its original state of efficiency

reading the explicit instructions governing main reservoir drainage at the end of each trip, the absolute necessity of this performance in order to insure the prevention of water in the brake pipe, the exacting requirements of, and insistence of, daily records of the performance of the duty with the specified penalty in the event of any failure to comply with the instructions. The absurdity of the situation often became apparent upon an inspection of the engines, the iron clad instruction had



No. 14. E. L. EQUIPMENT. DIAGRAM OF THE GENERAL TERMED THE E. T. BRAKE FOR ELECTRIC SERVICE. CONTAINS REFERENCE

With the temperatures shown above, they are sure to increase with the increase in the length of time the compressor is in constant operation, and with the increase in the temperature of the air cylinder the capacity of the compressor is sure to reduce, for the reason that the small quantity of free air that can be drawn into the air cylinder then expands so quickly when it comes in contact with the intense heat of the cylinder, that the small amount drawn in cannot materially assist in the reduction of the cylinder temperature, and under the conditions

until thoroughly dismantled, rebored and refitted, and still there remains a question as to whether it will ever regain the original state of efficiency.

The accompanying diagram of air pump and main reservoir piping gives the approved length and location of piping, and with reference to main reservoir drainage, it is of advantage to make the pipe connection to the last reservoir in such a manner that the water can flow back into the second or first one.

No doubt a great many of our readers have frequently been amused when reference to, they would frequently have a single main reservoir of from 20,000 to 30,000 cubic inches capacity, an air pump discharge pipe traversing the shortest possible distance between two points, and the discharge side of the air cylinder of the same identical shade of color as the top of the caboose cook stove. All of our wrong impressions and ridiculous mistakes, however, were not entirely confined to any single phase of air brake practice, for in many instances under modern conditions we find ourselves having a set-to with the effect until someone

turns our misguided efforts in the right direction.

In repairing the air cylinder, we believe that the most important points to be observed are, first, the fit of the air piston on the rod, to prevent a loose piston, a ruined or broken rod and possibly a pump failure. Second, the fit of the piston in the air cylinder which should be close enough to insure the entrance of some free air regardless of the fit of the packing rings. The writer has found it to be an excellent practice to have the cylinder rebored to the same size as the air piston to be used, then to touch the piston with a fine file until it can be forced into the cylinder.

If the cylinder is perfect the piston can be fitted so closely that the pump can undergo several overhaulings before a new piston need again be fitted.

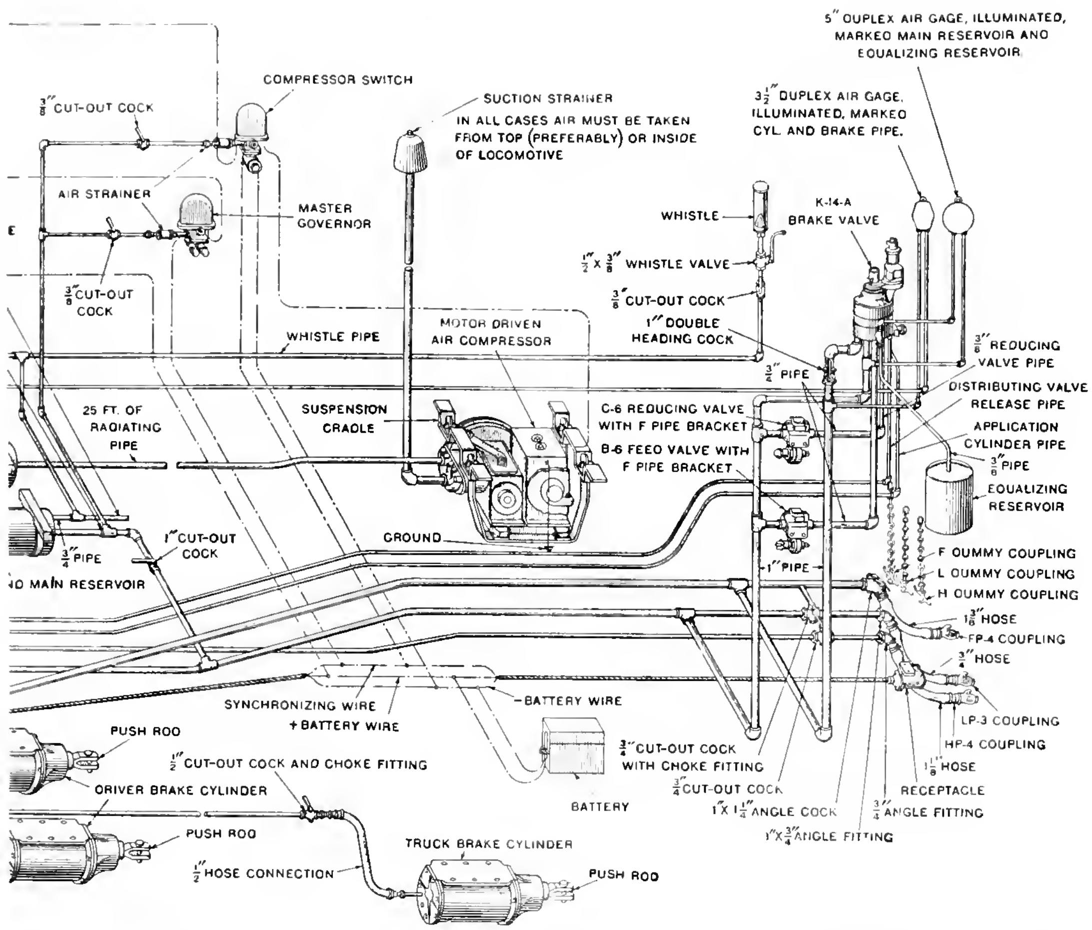
Third, is the lift and tightness of air valves. Care should be taken to know that there is no back leakage into the air cylinder through the threaded portion of the air valve seats or cages, and in measuring the lift of valves, 5/64 of an inch is about right, so that the lift will wear to 3/32 of an inch instead of away from 3/32.

Lastly, the fit of the packing rings is of considerable importance; they should be brought to bear all the way around the cylinder, regardless as to how it is accomplished, and before they are finished at the ends, they should fit neatly in the piston grooves without sticking, but it is better to leave them a trifle loose in the grooves than to attempt to file the sides of a thicker ring to fit a worn groove; however, with a properly fitted ring the wear of the grooves is almost negligible.

The idea is to attempt an air tight joint at the ends or where the rings come together, and a good practice is to attempt to lap the rings a trifle at the ends without having them piston bound, but care must be exercised in the attempt, and if the workman has not had plenty of experience it is best not to attempt to make them a light driving fit, because of the liability of becoming bound in the grooves. When the rings do become bound it is seldom due to any method of fitting; in nine cases out of ten it is due either to the edges of the piston striking some obstruction or to water flowing down the rod and corroding the rings while the engine is shopped or while the pump is not in use for a week or ten days.

The recommendations of the Air Brake Association specify that if packing rings are open 3/32 of an inch when placed in the smallest part of the cylinder, they should be renewed, and if the piston is 1/16 smaller than the cylinder it should be renewed, hence the foregoing may appear a trifle too exacting, but the recommendations also specify that there be no noticeable brake pipe leakage and, reading between the lines, the work of the compressor should be intermittent.

An accurate fit of the air end of the pump will insure the maximum possible efficiency, and it is frequently necessary, especially where pumps are subjected to the severe conditions shown up in a recent air brake test, the summary of which shows instances



ARRANGEMENT OF THE ELECTRIC LOCOMOTIVE BRAKE APPARATUS. NEXT MONTH'S ISSUE WILL TO THIS EQUIPMENT.

in where 2/11-inch pumps in good condition required 30 minutes and more to charge 100-car trains.

It is not a rare case to find two 9½ or two 11-inch pumps working continuously all the way over a division, and if those pumps are not in first-class condition and frequently lubricated, overheated pumps are sure to result.

Triple Valve Lubrication.

Triple valve lubrication has been for many years a thorn in the flesh of the air brake man. Suitable lubricant and the proper method of application has in itself constituted quite an air brake problem for the manufacturers of brake apparatus, as well as the air brake man, but at the present time a great many tests of a practical nature have been conducted and much valuable information has been derived and placed on record, so that definite and positive instructions concerning triple valve lubrication can now be formulated.

Fine dry graphite for the slide valve seats of triple, distributing and control valves is now recommended, however this is in the nature of a compromise and we will attempt to explain why it is the best lubricant obtainable for the purpose and incidentally why it is in the nature of a compromise.

We know first that if a heavy bodied oil or grease is used on the triple slide valve and seat, quick-action during service operation is almost sure to occur, or when oil or grease is used the slide valve under pressure is about twice as hard to move as when the valve and seat are perfectly dry and under many different experiments it is conclusively proven that oil frequently renders the valve 4 or 5 times as hard to move as when dry.

This may appear ridiculous to any one who considers only the frictional resistance obtained between the surfaces of two metals in contact, but in this problem the air pressure per square inch on the slide valve must also be considered and when its full effects are recognized, it conflicts with the usually accepted laws governing frictional resistance.

Air brake men now understand that oil or grease forms an air tight packing about the slide valve, excluding any air pressure from between the valve and its seat, whereas a perfectly dry valve and seat permits a slight leakage to the under surface of the valve, thus tending to balance the air pressure surrounding the valve and rendering it easier to move than when it is lubricated or to say hermetically sealed about its edges.

The resistance to movement of the dry slide valve is practically constant and while in motion, the lubricated slide valve may have less resistance, but after being at rest under air pressure for one or two minutes, this oil or grease packing very materially increases the resistance to movement until the slide valve is dislodged and brought into motion.

A very crude and somewhat exaggerated experiment that might serve as an illustration would be to place a flat piece of iron or a nut on a greasy engine frame and after a trip or two it will be necessary to hammer it to loosen it from the position from which it has imbedded itself in the grease and oil. In a similar way, but in a lesser degree, the triple slide valve imbeds itself in the oil or grease placed on it and its seat.

In the air brake works at Wilmerding, Pa., frictional resistance to the movement of a triple valve is found by the use of a mercury column, which gives absolutely accurate results, and in further efforts to determine the effects of oil or grease as a slide valve lubricant, a large number of triple valves after being lubricated and in service for a period of three months were removed and impressions of the slide valve face were taken and carefully examined with a microscope and in no case could any traces of lubricant be found after three months' service, hence the logical conclusion that if a triple slide valve runs perfectly dry nine months out of twelve, it can certainly run dry the other three months without showing a great deal of additional wear of the valve and seat. This is, of course, the answer to the question why undesired quick-action has so frequently manifested itself in epidemics immediately after a large number of triple valves have been cleaned and oiled.

From the information derived from many experiments, Mr. Turner took the stand that a dry slide valve and seat were the remedy for undesired quick-action and very conclusively proved it to the entire satisfaction of at least one railroad, and as it was accomplished by merely reducing the slide valve friction or lessening the load on or work of the triple piston, it also follows that the use of dry graphite still further lessens the friction of the slide valve or work imposed upon the piston.

Methods of using graphite and effects of brake cylinder lubricant working back into the triple valve either when dry or previously lubricated, at the present time constitutes a very live topic, the effects are quite well known, but the problem lies in keeping the valve and cylinder dry enough in service to obtain the desired results when using dry graphite.

In oiling or greasing the brake cylinder, it is difficult to convince the repairmen that too little lubricant is better than too much, just as it is difficult to get the repairmen to put up a feed valve without lubricating the supply valve piston or to clean a brake valve without lubricating the discharge valve piston, but after a little practical experience with the disorders that can be traced to excess lubricant he will gradually fall into line and use the specified amount and in the proper place.

During a session of the 1913 air brake convention, Mr. Turner was called upon to disseminate his views upon the subject of lubrication of triple valves and its connection with undesired quick-action, he said in part:

"Dry graphite is the best lubricant we can put on the slide valve. The only objection to its use is that men will put on such quantities of it that it will clog the ports and passages, then the remedy is as bad as the disease.

"It is an absolute fact that an unlubricated or graphite lubricated slide valve cannot in any way be responsible for undesired quick action. I want to make that statement as emphatic as I can, when you get the quick-action it is not due to the fact that you have graphite on the slide valve, but to the fact that you have no longer got it, water has entered in, or oil has entered in, or something has entered in and given that piston more work than it can perform. Someone here has said that brake pipe leakage causes the undesired quick-action, another says, water on the slide valve causes it, another says the engineer is responsible for certain cases, then let us separate the different cases and make an effort to prevent them, the disorder is either curable or incurable, it is either inherent in the triple valve, the brake pipe, the engineer or it is somewhere, possibly in all of them; let us find the part at fault and apply the remedy.

Most people's idea is that a triple valve is built so that its quick-action depends entirely upon the difference in the rate of reduction; if that were so, how would you ever get it on a 100-car train where it takes one minute and one-half to pull twenty pounds of air out of the brake pipe? Take a six-car train, where you can take out the twenty pounds in six or seven seconds, and then say that we have undesired quick-action more frequently on the 100-car train than on the six-car train and that it is due to the rate of reduction, that the engineer has pulled out too much air, or something else; explain these things to me; I am just as skeptical about these things as some of you seem to be about other things, dry graphite, for instance. If quick-action is due to the rate of reduction, why does it take place when we are reducing 20 pounds in 1½ minutes and not take place when we are reduce the 20 pounds in six seconds? That is the

thing that is hard for me to understand. This general supposition concerning quick-action is only true when the triple valve is lubricated with dry graphite. Just get that right in your own minds. Undesired quick-action is due to the differential that is built up between the brake pipe and the auxiliary reservoir, resulting from the excessive friction on the slide valve or some other part, causing the slide valve to hang until sufficient reduction takes place to break it loose, then it travels all the way to quick-action.

If you do not believe that, just take a chronic kicker, remove the graduating spring and put in a stronger one, say one that will offer a resistance of five pounds to the piston, if you can then get quick-action with a service reduction, you will have performed a miracle, an absolute miracle, for it cannot be done!

New Steam-Gas Locomotive.

It is a well-known fact that in the one hundred and forty years which have elapsed since Watt built the first steam engine, little progress has been made in the development of new principles in connection with this science. The Watt engine had a thermal efficiency of about 8 per cent., while the average thermal efficiency now obtained in steam engineering is about 10 per cent., and in railway locomotive engineering only about 5 per cent. The average thermal efficiency obtained in present-day gas engineering is about 20 per cent., but the gas engine is not reliable in starting and, therefore, cannot be depended upon.

A new and marked improvement in steam-gas engineering has been brought to our attention by Mr. H. Ray and Mr. C. J. Smith, Toledo, Ohio. The device embodies a boiler and a steam-gas engine, the boiler containing both a primary and a secondary heater and a gas producer, the steam-gas engine consisting of a single-acting steam engine and a four-cycle gas engine.

The primary heater consists of a gas furnace, located just below the water line in the boiler, the heat of combustion in the furnace being used to volatilize the fuel in the gas retort (a metal tube located at the point of highest temperature in the furnace), and to convert into steam the thin layer of water maintained just above the top line of the furnace, the residue of heat passing through a descending furnace-gas conduit which emits the cooled furnace gases at the bottom of the boiler.

The secondary heater consists of two conduits, located in the boiler, one on each side of the furnace and furnace-gas conduit, to utilize the heat from both the exhausts of the steam-gas engine, the gas exhaust entering the conduits above and the steam exhaust entering the conduits below the furnace, both descending to the bottom of the boiler.

Suitable conduits are provided to circulate boiler water in and through the water-jacket of the cylinder.

The boiler and gas producer are both connected to a double-acting steam-gas engine, using superheated steam in the single-acting crank end and hot gas, direct from the retort, in the four-cycle head end of the cylinder, the exhausts from both ends of the cylinder passing through the exhaust conduits in the boiler, which are economizers.

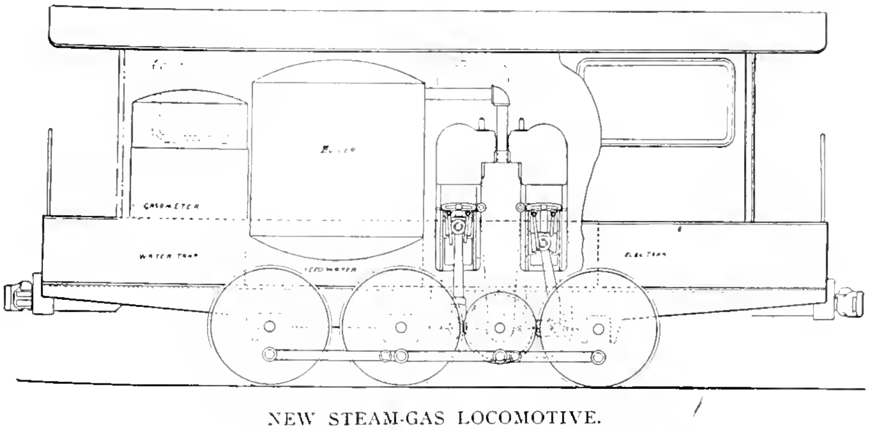
The combination steam-gas cylinder, together with the arrangement of the boiler, results in the heat units largely wasted in steam engineering and those usually wasted in gas engineering being returned to the boiler to make more steam; hence the high thermal efficiency which is unattainable in any other system of engineering.

The fuel is prepared for combustion, in the retort in the furnace.

Power is primarily generated in the steam, becomes gasified in the retort, by the heat from the combustion of gas in the furnace, and passes at high temperature to the burner in the furnace and to the gas engine.

The engine receiving steam in the crank end and gas in the head end of the cylinder operates, as single-acting steam and four-cycle gas, on the opposite ends of the piston in the same cylinder, the superheated steam being admitted to the crank end of the cylinder and the hot gases being drawn into the head end of the cylinder, compressed and exploded. Gas being used in the head end, instead of the crank end of the cylinder, obviates injury to the piston rod and piston rod packing.

The construction of the steam end of the cylinder, the piston, the piston rod, the guides, the connecting rod, the crank shaft, and the valve gear and reversing mechanism is the same as that generally used in steam engines, and nothing new or untried is introduced. The construction of the gas end of the cylinder, its



NEW STEAM-GAS LOCOMOTIVE.

steam boiler from the combustion of hot gas in the furnace, the hot gas being supplied direct from the retort to the burner; and, secondarily, in the internal-combustion gas engine, this engine using the hot gas direct from the retort; thereby obviating the losses due to cooling and reheating the gas, as is customary in the producer type of gas engine, the heavy hydrocarbons which ordinarily condense thus being burned while gaseous.

The steam is superheated by the initial high-temperature conduits located in the steam-chamber at the top of the boiler. The temperature of the exhaust gases and exhaust steam reduces as these exhausts approach the bottom of the boiler; and these exhausts, when emitted from the bottom of the boiler in the form of gas and water, are cooled to within a few degrees of the temperature of the feed-water.

In the top of the furnace is a retort, consisting of a metal tube into which the fuel is injected by a jet of steam. This fuel (crude oil or any of its distillates, or possibly powdered coal), with the inlet and exhaust valves and operating mechanism is the same as that generally used in gas engines. That portion of the cylinder in which is located the combustion chamber is water-jacketed.

The accompanying illustration shows the general design of the engine and its adaptability to a locomotive designed to equal in working capacity that of an ordinary switching locomotive having 19 by 24 in. cylinders. In this design a pair of double-acting twin-cylinder steam-gas engines are shown.

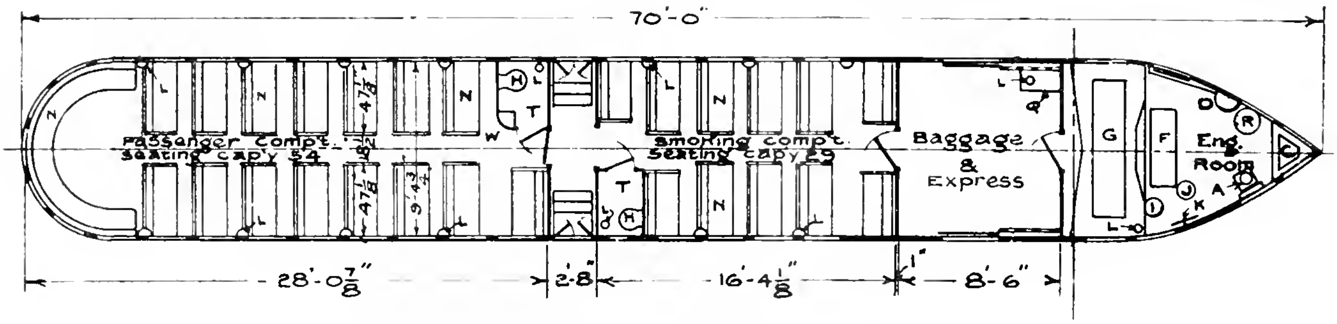
The principal dimensions of this steam-gas locomotive are as follows:

Height of floor from rail....	5 ft. 10 ins.
Height over all............	13 ft. 2 ins.
Width over all............	9 ft. 6 ins.
Length of frames..........	26 ft. 9 ins.
Wheel base	11 ft. 3 ins.
Diameter of drivers........	51 ins.

Profiles of the western lines of trans-continental lines show that the Canadian Northern has a maximum grade of .7 per cent. with an elevation of 3,706 feet. The Grand Trunk Pacific a grade of 1.0 per cent. and an elevation of 3,719 feet.

McKeen Gasoline Motor Cars for the Sunset Central

New model McKeen gasoline motor cars (type "C") have been built for and delivered to the Morgan's Louisiana & Texas Railroad, Galveston, Harrisburg & San Antonio Railroad and Houston & Texas Central railroads of Louisiana and Texas. One of the new cars and front truck are herewith illustrated, from which it will be noted that the car body is practically identical with the original design of the McKeen standard car, the tri-unit of operation principle being (1) vehicle, car body, (2) prime mover, internal combustion engine, and (3) mechanical transmission. With this mechanical transmission of 96 per cent. efficiency—a transfer to the driving wheels of 96 out of every 100 horsepower of the crank shaft renders improvement of transmission efficiency improbable. While the latest model motor truck maintains the McKeen standard motor car principles, the new design is the result of nine years' experience in the manufacture of these cars and combines the collective experience of fifty odd railroads using this equipment. While the new car is of no greater efficiency its up-keep and maintenance charges are materially reduced. A seven year old car recently made the attractive record of covering over 5,000 miles during the month, earning $117 per day at a total operating charge of 14 cents per mile. It is beyond reason to expect any greater economy or greater efficiency with such earning capacity equipment.



PLAN OF McKEEN MOTOR CAR FOR THE SUNSET CENTRAL.

The gasoline engine is really a motor, entirely enclosed and practically fool proof; the machinery is self-lubricated, operates automatically as far as practicable, the idea being to eliminate almost entirely the personal equation of the operator. The chief features of the new power truck are: Integral steel casting side frames. M. C. B. wheels and axles. New design driving box permitting its removal without dropping the wheels. The machinery and all moving parts are enclosed in oil-tight, dust-proof, fool-proof casings and housings; eliminating the wear and tear thereby, and while decreasing the liability of accident also requires less attention from motorman. The crank shaft, cam shafts, bearings, rods, air pump, water pump, etc., are automatically lubricated by an improved circulating oiling system, in which the lubricant repeats its circuit continuously, with minimum loss.

EXTERIOR VIEW OF THE McKEEN MOTOR CAR FOR THE SUNSET CENTRAL.

Located between the cylinder units is shown the auxiliary hand oiler whereby the motorman can oil the crank and rod bearings in five seconds, thereby facilitating the lubrication of the journals in starting on a cold morning. In case of hot journal, emergency oil can be applied through this auxiliary oiler without the motorman moving from his seat. The manifold pipes are water jacketed by means of which the gases are heated and equally distributed to the different cylinders. Increased water space around valves and cylinder heads to permit of overloading the engine. The valves are of Tungsten steel which will not distort and will perform their duties though red hot. The special design of triple piston ring is used; it does not give any better compression but it lasts longer and guarantees the compression, even though pistons and cylinders are badly worn. The new location of the throttle and spark levers renders same particularly convenient and within easy reach of the motorman..

In the new design of mechanical transmission a multiple disc friction clutch has been developed which, with the increased number of friction elements, gives more positive action and greater efficiency, the larger friction surface reduces the rate of wear and the life of the clutch is obviously enormously prolonged. The speed gears of the transmission have been proportionately increased in strength, the now thoroughly developed efficient herringbone type gear is used instead of the ordinary involute spur gear. Greater strength, greater efficiency and enormously prolonged life is gained thereby. Altogether the new power truck has its wearing surfaces increased all the way from two to six-fold. The whole mechanism is simplified, the number of parts reduced, with

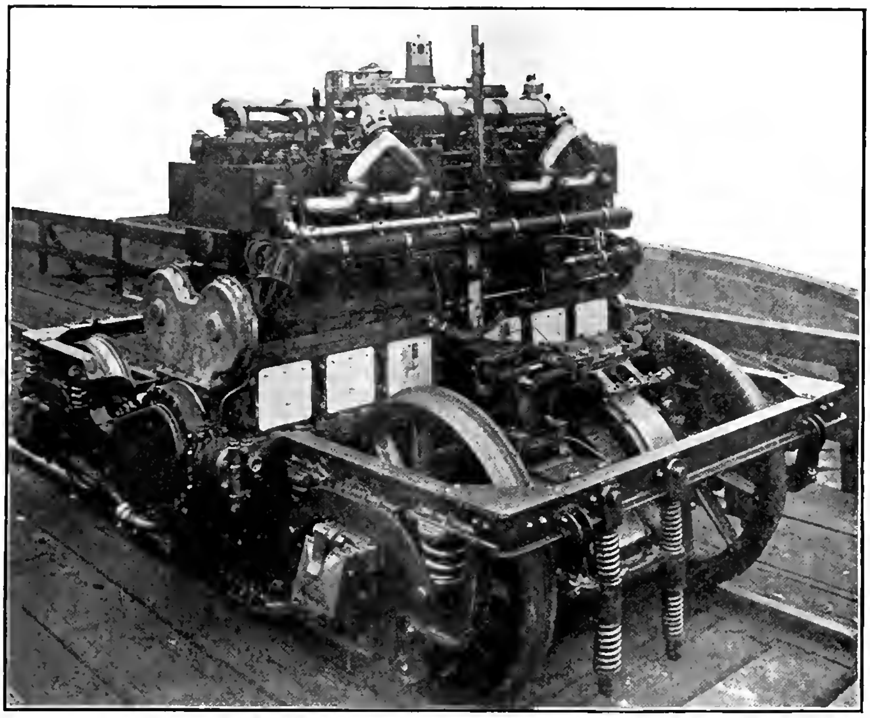
greater reliability and freedom from accident. Fifty per cent. reduction in the cost of repairs is easily obtained. This power truck operates with minimum attention while on the road and its time between shoppings is almost entirely controlled by the wear of the driving tires.

The general specifications of the Sunset-Central cars are:

Engine, 200 horsepower McKeen standard, six cylinder, air starting and reversible.

Weight of car in working order	78,000 lbs.
Length between pulling faces of couplers	72 ft. 3¾ ins.
Length over end sills	70 ft. 0 ins.
Length of engine compartment	13 ft. 8 ins.
Length of baggage compartment	8 ft. 6 ins.
Length of smoking compartment	16 ft. 4⅛ ins.
Length of passenger compartment	28 ft. 0⅞ ins.
Width inside	9 ft. 4¾ ins.
Width over side sills	9 ft. 8 ins.
Width over sheathing	9 ft. 8¼ ins.
Width over all	10 ft. 2¾ ins.
Height, top of rail to top of car (light)	11 ft. 9 3/16 ins.
Height, floor to ceiling at center of car	7 ft 5⅝ ins.

Seating capacity, passenger compartment, 54; smoking compartment, 29; total, 83.



FRONT TRUCK AND MOTOR OF McKEEN MOTOR CAR.

A Thoughtful Superintendent.

General Superintendent Blaser, of the Baltimore & Ohio Railroad, was walking through the yards at Keyser, W. Va., recently, on an inspection of the terminal, when his attention was attracted to a locomotive standing on one of the spur tracks. It was locomotive 1788, used in helper service on the Piedmont grade. The 1788 is one of the Wooten engines, known to railroad men as a "snapper."

"That engine is one of the most efficient pieces of machinery on the property," said the general superintendent to those with him. "It is a striking example of what the proper attention will do in keeping machinery in good working order; and to my knowledge has not been in the shop for heavy repairs in the last ten years. This is due to the fact that Engineers Carey and Hines, who operate the locomotive on the day and night shifts up the mountain grade, take the greatest care of the engine and always keep it tuned up to good working condition.

"When a nut or bolt needs adjusting, the engineer in charge at such time gives it careful attention, with the result that the 1788 is never heard 'pounding,' nor is there any lost motion in the mechanism, which causes wear and tear on the motive power."

Mr. Blaser explained that the engine was in the Keyser terminal having its boiler washed out, flues cleaned and otherwise gone over; but that it is never necessary to replace the boiler, a driving wheel or other heavy part.

The engineers also pay as much attention to the condition of the engine's cab as they do to the proper adjustment of her working parts. Carey and Hines tell the officials that the reason such care is given to the general appearance of the engine and to the cab is because during the greater part of their working time the locomotive cab is their homes, and they feel as much pride in keeping their working quarters in order as they do in the neat appearance of their homes in Keyser.

Locomotive engineers form attachments for the motive power they operate. Many of them give their engines pet names and know just what they will do in developing their maximum capacity to handle trains on the road. This co-operation between the men and the company saves many a dollar in operating expenses by keeping the repair charges down to a minimum.

Electrolysis of Water and Other Pipes.

It is a well-known fact that there are destructive effects on metal pipes laid underground, due to the electric current from street railroad systems. Underground water mains have broken down and pipes have been weakened.

The general nature of the action on the pipe is as follows: The electric current from a grounded trolley system, flowing back to the power station, will follow the path of least resistance. Large quantities of current will leave the running rails, due perhaps to poor bonding, and pass through the earth, to the nearest water pipes or gas mains. The current will flow through these pipes to the nearest point to the power station, when it will leave the pipe and pass through the earth to the station. The point where the current leaves the pipe is the point where the damage is done, for the iron of the pipe wastes away. This action is termed electrolysis and there is always enough dampness, and common soil has the necessary salts, to cause this electro-chemical action.

The difference of potential or voltage necessary to bring about this action is very small. Only a fraction of a volt is necessary. This action is given a great deal of thought and attention by the railway companies. By careful study and exhaustive series of readings the exact conditions as to the voltages of pipes, etc., can be known, and by the joining together of certain points by cable, the electric current can be prevented from leaving the pipes to pass through the earth, and the electrolytic action can be reduced to practically a negligible quantity.

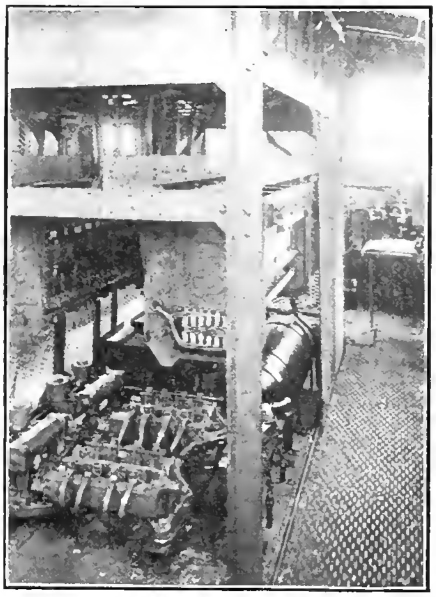
Canadian Railway Subsidies.

The railways of Canada have been largely built under different forms of Government, State and municipal aid. The principal forms of the assistance granted had consisted of land given, cash subsidies, loans, the issue of debentures, and the guarantee of bonds or interest. The total area of land granted as subsidies to steam-railway companies by the Dominion and Provincial Governments amounted to the close of June, 1912, to 56,052,055 acres. The Dominion Government has itself undertaken the construction of the eastern portion of the National Trans-Continental Railway from Moncton to Winnipeg, and the expenditure made upon the line to the close of March, 1912, was $116,533,769.

Electrical Department

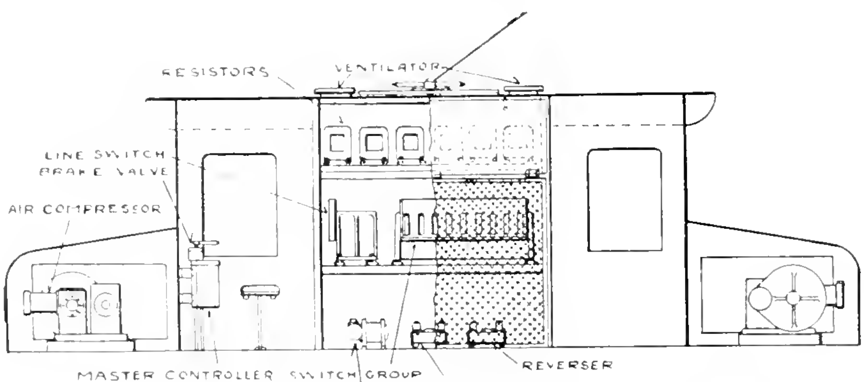
Electric Locomotive Design.

The electric locomotive is becoming more and more each day a profitable revenue producer for electric railways It is supplanting the steam switcher locomotive where freight is moved to and



INTERIOR OF LOCOMOTIVE.

from the main line and a manufacturing plant, for this freight can be handled at a cheaper cost with the electric locomotive due to the much lower maintenance cost and the lower cost of electric power over coal.



SIDE ELEVATION, STANDARD BALDWIN WESTINGHOUSE LOCOMOTIVE EQUIPMENT LAYOUT.

It is important that a locomotive be laid out so that its equipment is easily accessible for inspection and maintenance, thus insuring reliable operation and continuity of service.

The standard Baldwin-Westinghouse electric locomotives, so many of which are in service have incorporated in them very valuable constructional features. A great deal of thought has been given to the equipment layout. Four essential points are kept in mind for each locomotive built.

First: Such apparatus is selected as will meet the service conditions under which the locomotive is to operate.

Second: The apparatus on the locomotive is mounted in such a way that each part will operate to the best advantage.

Third: The apparatus is arranged so as to give easy access to all parts.

Fourth: The apparatus is mounted in such a way as not to require unnecessary expense for equipping and maintaining.

To accomplish the above all of the main-circuit apparatus, i. e., the apparatus handling or controlling the electric current to the motors is mounted in the center of the locomotive, with an aisle either side, and surrounded with suitable metal screens as a protection against accidental contact. In this manner all of the apparatus is assembled completely in one part of the locomotive instead of being scattered in different locations.

The Development of an Electric Tractor for Handling Freight Cars Over Tracks Laid on City Streets.

A very interesting paper was read on the above subject before the Society of Automobile Engineers recently, by T. V. Buckwalter:

It has been the practice for many years, in certain large cities, to operate freight cars over tracks laid in the city streets, thus providing freight facilities at industrial establishments remotely located from the main railroad tracks or sidings. This practice has been a great convenience for the material can be loaded in chutes direct between cars and buildings, thus eliminating transportation by horse drays or motor trucks.

It has been the practice to use horses for the motive power of these freight cars, for there are objections to the use of a steam locomotive on the part of the residents and heavy gasoline and electric motor trucks have not been successful.

A string team consists of 8 horses. In the early days they were hitched in a single line but now the practice is to have 4 pairs. Large, slow, steady horses are used costing at the present time in the neighborhood of $350 each.

As early as the summer of 1911 the Pennsylvania Railroad considered the best means to replace the horse teams. Manufacturers of the heaviest and most powerful motor trucks were appealed to with the result that a few ranging from 10 ton to 5 ton and from 40 to 60 horsepower were tried out. Any one of the trucks submitted would pull a 50 ton car on the level, but all experienced trouble in starting and none were able to pull a loaded car on 50-ft. radius curve or on a 2 per cent. grade.

These tests clearly demonstrated that an entirely new design was necessary, several times more powerful than the largest motor truck, and which would compare in power with steam locomotives rather than automobiles. Since large draw-bar pull would be required, traction must be obtained from all wheels, which on account of simplicity must not exceed four. Also for "Safety First" brakes must be applied to all four wheels.

The outcome of this problem was the building of the electric tractor which comprises a substantially constructed steel frame with an enclosed cab located at the exact center of the machine and to still further provide for operation in either direction with equal facility, the steering wheel is located in the center of the cab. The controller and brake lever are in duplicate and are mounted on each side of the cab and are conveniently arranged so that the driver can control the steering wheel with one hand and the controller and brake with the other hand. Duplicate sets of controller and brake levers are symmetrically arranged as respects the steering wheel and the machine in general.

The cab is provided with windows on all four sides to provide clear vision in every direction, not only along the track, but also in any direction from which traffic might approach. Standard railroad automatic couplers are mounted on

each end of the machine to provide for operation from either end. The machine is mounted on four wheels which are arranged for driving, braking and steering.

The electric storage battery is mounted in a frame below the cab. Following are dimensions, etc.:

Wheel base	12 ft. 6½ ins.
Tread	7 ft. 0 ins.
Overall length	22 ft. 8½ ins
Overall width	8 ft. 4 ins.
Height	11 ft. 2⅜ ins.
Normal draw-bar pull	8,000 lbs.
Weight, complete	28,850 lbs.

The driving apparatus is constructed in duplicate, the drive on each pair of wheels being exactly similar. An electric motor drives the wheels through gearing and through well known universal pinion located on the ends of the motor countershaft.

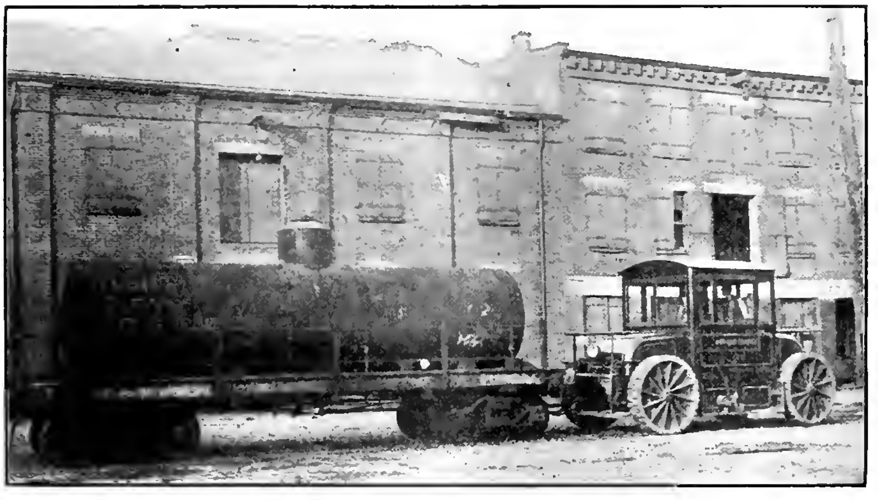
One of the important reasons for the substitution of motive power for animal power was that of obtaining a more reliable and efficient braking system. Automatic air brakes were installed, the air being furnished from an air compressor electrically driven.

The tractor was placed in service in February, 1913. For the first seven months the average daily operation and service per month were as follows:

Hours in service	8.28
Miles run	13.0
Total cars handled	29.9
Total weight (tons)	1,003

One of the most interesting facts of the tractor is that the cost of operation is a great deal lower than animal power. The total charges for the seven months including interest, depreciation, etc., was $4,627.88. If horses had been used to move the total of 4,935 cars the cost would have been (at $1.86 a car) $9,179.10. The tractor made a saving of $4,551.22 or 64.5 per cent. saving on the investment. A further study of the costs gives the following data:

Cost of service per car ($4,627.88 ÷ 4,935)	.938
Cost of service per ton ($4,627.88 ÷ 165,524)	.028
Average number cars per mile	2.4
Cost of service per ton mile (.028 × 2.4)	.067
Cost of service of electric tractor per working day	27.87
Cost of service by team per working day	55.29



THE ELECTRIC TRACTOR.

Rail Bonds.

In the case of electric railroads or steam railroads operating over a section by electricity it is very important that the rail joints are bonded. By bonding we mean the placing of copper cable or strap around the rail joint, either end of the bond being securely fastened to the rail. It is very essential that the return circuit should be the best possible. Poor bonding will cause the electric current returning to the power house along the rails to leave the same, passing through the earth to water pipes, etc. The passing of current to iron pipes or iron work in the presence of moisture causes electrolysis, which attacks the pipes, causing corrosion.

There are many styles and sizes of bonds. Most of the bonds are applied to the rail by pressure or hammer riveting, but some are soldered.

The Tungsten Lamp.

It has been only about five or six years that the metal filament lamp has been used commercially in this country. Previous to that time all of the electric lamps were of the so-called carbon type. The filaments were carbon. Although the current taken by the carbon lamp is small, about ½ ampere for the 110-volt lamp, still when these lamps are burned by the hundreds the power amounts to a large quantity.

It was found that the metal filament lamps were great savers of electric current and that the metal known as Tungsten was the most satisfactory. The tungsten lamp was first placed on the market in 1907, and the use of this type has become today almost universal; the carbon lamp being practically replaced.

When the tungsten lamp was first brought out, the electric power companies feared that their income would be reduced; on the contrary their income has been increased by the extension into new fields, made possible by the superiority of the new lamps.

Tungsten is one of the heaviest metals known and has a very high melting point over 3,000 degrees centigrade. Due to its ability to remain stable at very high temperatures, and its ability when at this high temperature to give off a large amount of light, the tungsten lamp is of superior efficiency.

Tungsten has other interesting characteristics; it oxidizes at a very low temperature, although the melting point is very high. It also softens at a low temperature, and filaments of special forms can be formed by winding straight pieces on hot mandrels.

Quick Work.

The Westinghouse Electric & Mfg. Co. reports the recent shipment to a large railway company in the Middle West of a twenty-six panel switchboard in record breaking time.

On the 28th of November the contract for the board was signed, calling for delivery in twenty-six days, with a bonus and penalty clause. On December 10, twelve days later, the entire switchboard was shipped complete from the works, and it was done without employing any overtime.

The board was designed to control one 800 kw., 250-volt D. C. generator; two 37½ kw., 250-volt D. C. generators; two exciters; two 850 kva., 480-volt, 3-phase A. C. generators, the remainder of the panels being devoted to A. C. and D. C. feeders.

The Canadian Pacific.

A total of 1,700 miles of railway has been under construction during this season by the Canadian Pacific Railway, according to statements made by J. G. Sullivan, chief engineer of the western lines of the company, who has returned to Winnipeg from an extended tour of the work being undertaken. The amount of material which has been handled by the construction department of the company has been more than was moved during any period in the building of the Panama Canal, and represents no less than 30,000,000 cubic yards, and if the work that has already been accomplished on the Transcontinental road be added, Canada is making extraordinary extensions in railroads.

Instructions Governing Application and Operation of Vacuum Tube, a Device for Determining Amount of Vacuum in Ash Pans.

By W. C. Hayes, Superintendent Locomotive Operation, Erie Railroad.

Apply 1¼-in. pipe in the center of ash pan, diagonally, or crosswise of pan, pipe to be perforated with two sets of holes, drilled at an angle of 45 deg. Holes to be ⅛-in. in diameter. Place the pipe in ash pan as near grates as possible, so as not to interfere with shaking of grates, and have small holes set toward grates. Put a cap on end of the pipe extending from the right side of ash pan: reduce the other end to ⅝-in. and run a ⅝-in. pipe to the cab on left side. Fill vacuum tube with water until it appears at the point marked "X" in both glasses. There is now atmospheric pressure on water in both glasses.

When water rises in glass connected to the ash pan, it indicates that a portion of the atmospheric pressure is being taken from top of water in that glass: the atmospheric pressure being on top of water in other glass will force the water down an equal distance. The reading should be made as follows: When the water raises 1-in., it also lowers 1-in. in opposite glass. Add these two together making a total of 2-ins. If water raises 2-ins., it also lowers 2-ins. in corresponding glass, making a total of 4-ins., adding the variation of both glasses together.

The purpose of the vacuum tube is to ascertain whether a locomotive is getting free circulation of air in ash pan, which is absolutely necessary to make a good steaming and free working engine. Locomotives will generally tear holes in the fire either in front or back end and perhaps along the sides of the firebox. Others will burn an even fire, but will not steam, indicating that engine burns a dull red fire and that the right temperature has not been secured. *Oxygen* is necessary to form perfect combustion and should be supplied evenly throughout the entire grate surface. Careful inspection should be made to see if there are any holes cut in pan at point where holes are being torn in the fire, as the air will run in through the reserved opening and take the shortest possible course through the fire to fill vacuum in firebox created by the exhaust. Opening the pan on all sides of the hopper will overcome this. After opening pan to furnish sufficient air inlet it may be possible to open up nozzle as it does not require as strong a draft to draw the proper amount of air through the larger openings in the ash pan. Upon inspection a vacuum will no doubt be found in ash pan and instead of closing nozzle to make the fire burn, open up the ash pan. It has been found that an engine is not right when the water in vacuum tube varies over ⅜-in. and the nearer it remains perfectly level, the nearer perfect combustion is secured.

Where there is an insufficient air inlet in ash pans, large savings have been made in opening pans without changing the size of the nozzle. Opening the ash pans on engines will lessen the pull on the firebox door. The opening in the ash pans should always be equal to the square of the flues. Too much air cannot be furnished in ash pans. Openings should be as nearly uniform as possible in front, sides and back. If pan is opened up around mud ring, drop it away far enough to insure a free access of air, otherwise the air will rush in opening and up along side sheets, tearing fire but along the sides. It is more than likely that in some cases, engines will not steam after opening ash pans, but in case they do not, opening of the ash pans should not be condemned, as the reason for this is too much air being drawn through the fire. The remedy is easily applied, viz., open the nozzle which should be done at once.

It should always be borne in mind that it requires a considerable quantity of air (oxygen) to secure full benefit of all the B.T.U.'s from each pound of coal, thereby preventing it escaping in the form of carbon dioxide or black smoke.

Following is report of test of water evaporated and coal consumed on engine 793 with ash pan closed as per standard and opened as outlined or to show an absence of vacuum in pan. These tests were made on the Greenwood Lake Division, train 585, engine 793, six cars (same equipment each night); Engineer, H. W. Smith; Fireman, N. M. Cable:

TEST NO. 1.

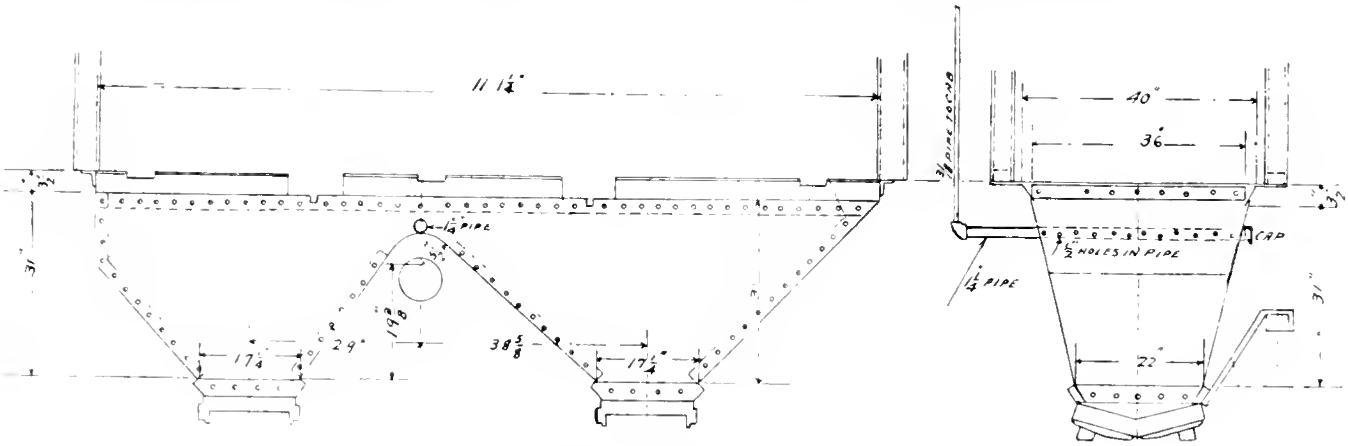
Weather, clear; size of nozzle, 4½-ins.; opening in ash pan, about 138 square inches; vacuum in ash pan, 2½-ins.; vacuum in smoke arch, 13½-ins.; coal consumed, 2,000 lbs.; water evaporated, 14,700 lbs.; lbs. water per lb. of coal, 7.3; lbs. coal per loco. mile, 93; hook used, twice; depth of fire leaving Jersey City, 14-ins.; depth of fire arriving Essex Fells, 10 ins. No coal put on fire until switching was finished and ready to leave Essex Fells. Average steam pressure, 172.7 lbs.

TEST NO. 2.

Ash pan opened to show an absence of vacuum; weather, stormy; size of nozzle, 4½-ins.; opening in ash pan, 678 square inches; vacuum in ash pan, 0; vacuum in smoke arch, 11-ins.; coal consumed, 1,520 lbs.; water evaporated, 14,625 lbs.; lbs. water per lb. of coal, 9.6; lbs. coal per loco. mile, 67.1; average steam pressure, 177.7 lbs.; hook used, not used; depth of fire leaving Jersey City, 14-ins.; depth of fire arriving at Essex Fells, 6 ins. No coal put on fire until switching was finished and ready to leave Essex Fells. Ash pan had four holes cut in sides 8-ins. x 18-ins., one in front 8-ins. x 30-ins. and one in back 9-ins. x 30-ins.; all covered by netting.

TEST NO. 3.

Weather, clear; size of nozzle, 4¾-ins.; opening in ash pan, 678 square inches; vacuum in ash pan, 0; vacuum in smoke arch, 11-ins.; coal consumed, 1,780 lbs.; water evaporated, 14,625 lbs.; lbs. of water per lb. of coal, 8.2; lbs. of coal per loco. mile, 79 lbs.; average steam pressure, 175.5 lbs.; hook used, three times; depth of fire leaving Jersey City, 24-ins. partly coke; depth of fire arriving Essex Fells, 5-ins. No coke put on fire until switching was finished and ready to leave Essex Fells.



SKETCH SHOWING 1¼-INCH PIPE IN ASH PAN.

TEST NO. 4.

Weather, clear; size of nozzle, 5-ins.; opening ash pan, 678 square inches; vacuum in ash pan, 0; vacuum in smoke arch, 11-ins.; coal consumed, 1,585 lbs.; water evaporated, 1,400 lbs.; lbs. water per lb. coal, 8.8; lbs. coal per loco. mile, 70.4; average steam pressure, 171 lbs.; hook used once; depth of fire leaving Jersey City, 24-ins. partly coke; depth of fire arriving Essex Fells, 5 ins. Six scoops of coal put on fire at Essex Fells before turning the engine.

TEST NO. 5.

Weather, clear; size of nozzle, 5-ins. with a pipe placed inside basket netting 12-ins. in diameter, 14-ins. high, the idea being to prevent steam expanding in basket netting; opening ash pan, 678 square inches; vacuum in ash pan, 0; vacuum in smoke arch, 12-ins.; coal consumed, 1,476 lbs.; water evaporated, 14,000 lbs.; lbs. water per lb. coal, 9.5; lbs. coal per loco. mile, 65.6; average steam pressure, 174 lbs.; hook used twice; depth of fire leaving Jersey City, 24-ins. all soft coal; depth of fire arriving Essex Fells, 5-ins. Six scoops of coal put on fire at Jersey City after getting signal before bags were opened and six put on at Essex Fells, dense smoke at this point.

TEST NO. 6.

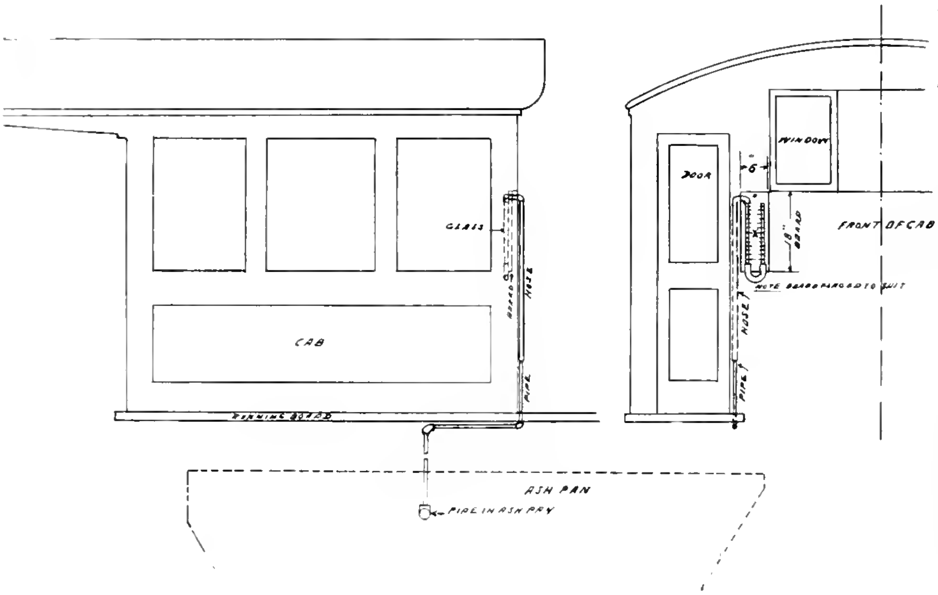
Weather, clear; size of nozzle, 5-ins. with pipe inside basket and bevel on nozzle top; opening ash pan, 678 square inches about; vacuum in ash pan, 0; vacuum in smoke arch, 12-ins.; coal consumed, 1,315 lbs.; water evaporated, 15,000 lbs.; lbs. water per lb. coal, 11.3; lbs. coal per loco. mile, 58.4; average steam pressure, 172 lbs.; hook used twice; depth of fire leaving Jersey City, 24-ins. all soft coal; depth of fire arriving Essex Fells, 4-ins. Eight scoops of coal put on fire at Essex Fells causing dense black smoke.

During test No. 1 had pipe attached to vacuum tube in cab and connected to a perforated pipe in ash pan, one foot from grates in center of pan. Opening in pan 4 ins. x 30-ins. front end. Two holes 8-ins. in diameter in back end; total 220 square inches. This was covered by netting, the wire closing up $^3/_8$-in. in every square inch or 82 square inches, leaving an opening of about 138 square inches.

Test No. 2 was carried out on the same lines as test No. 1 as to depth of fire and condition of fire at Essex Fells, except in test No. 1 fire was very dirty at Essex Fells. Tests No. 3 and 4 had about 50 per cent. coke on fire leaving Jersey City. Tests No. 4 and 5 had entirely too heavy a fire leaving Jersey City to compare with any of the former tests, it being 24-ins. and new fire started in engine at 1.45 p.m., leaving time of train 5.45 p.m.

The vacuum in smoke arch was held about the same in tests 2, 3 and 4 after the ash pan was opened. In tests 5 and 6 it was a little higher, caused, it is believed, by the heavy soft coal fire leaving Jersey City. There was a very noticeable difference in the elimination of black smoke, proving beyond a doubt that there has not been enough air admitted through fire heretofore. It also stopped engine from tearing fire out in front and back ends of firebox. The fire could be carried much lighter and it did not get nearly as dirty or clinker as much.

Engine steamed much better than before until 5-ins. nozzle was used, when the steam pressure would drop very quickly and it was hard to get it back. Every night, between Cedar Grove and Verona, steam pressure would drop from 180 lbs. to 165 lbs., a distance of two miles, without pumping the engines. In each of the tests less coal was consumed and a higher evaporation of water showed up with pan opened.



SKETCH SHOWING TESTING GAUGE IN CAB.

To Improve Old Vise Jaws.

After an indifferent vise has been in use for some time, the inside faces of the jaws become polished so that the vise will not hold a piece of round stock without permitting slipping just as soon as any pressure is applied on the work. A good and a cheap way, according to an exchange, to put the vise again into fine condition is to screw a section of an old file on each of the jaws so that the file teeth will furnish the "bite" that is necessary to prevent slippage of the work. Of course, before the file can be drilled, it must be softened, but as there are generally plenty of old files around the shop there is really no necessity for rehardening the tool. If the jaws of the vise have been hardened, the point of the drill must needs be hardened and a turpentine drip used before it can be drilled, but a vise that has lost the teeth from the jaws with short usage is hardly likely to have jaws that are hardened to any very considerable extent.

The Effect of Drilling Holes in Steel.

When holes are drilled and then reamed in soft-steel bars the metal materially increases in strength, the average limit of elasticity improving 12.3 per cent. and the average tensile strength 9.2 per cent. This phenomenon is explained thus: In putting together the parts of a test piece broken under tension, it is found that the two ends do not coincide; and that, while the edges make a good contact, the central parts do not, thus indicating that the rupture begins at the centre, and that the edges have a higher tensile resistance than there is along the axis of the bar. Therefore, if several holes are drilled so as not to injure the material too much, as might be the case with punching, the average tensile strength of the section across the holes, per unit of metal, will be higher than before the holes were drilled, since each hole creates, so as to speak, additional edges.

About Belting.

A reliable authority on belting says that it is generally conceded that when the smooth side of a belt is placed next to the pulley, the horse-power transmitted is about thirty per cent. greater than when the rough side is next to the pulley. With small pulleys a greater equipment is necessary because the contact is more or less imperfect. The lack of perfect contact prevents the adhesion between the belt and the iron pulley which might be obtained with a smooth belt on a smooth pulley. When the rough side of the belt is put over a small pulley, you experience the same conditions as with a wrinkled belt, which produces imperfect contact. These are small details but they count for efficiency in the operation of a machine shop.

Items of Personal Interest

Mr. Karl Hanson has been appointed division signal foreman of the Santa Fe, with office at Chanute, Kan.

Mr. E. C. Smith has been appointed president of the Southern New England, with office at St. Albans, Vt.

Mr. R. McLaren has been appointed general foreman of shops of the Bangor & Aroostook, at Oakfield, Me.

Mr. E. E. Root has been appointed master mechanic of the Monongahela, with office at Brownsville, Pa.

Mr. J. A. Read has been appointed master mechanic of the Macon & Birmingham, with office at Macon, Ga.

Mr. O. F. Bennett has been appointed general manager of the Union & Glen Springs, with office at Union, S. C.

Mr. J. W. Gibbs has been appointed master mechanic of the Northern Alabama, with office at Sheffield, Ala.

Mr. R. Laurence has been appointed general manager of the Santa Fe, Raton & Eastern, with office at Raton, N. M.

Mr. C. L. Sykes has been appointed master mechanic of the Orangeburg Railway, with office at Orangeburg, S. C.

Mr. G. H. Davis has been appointed master mechanic of the Manchester, Dorset & Granville, with office at Proctor, Vt.

Mr. Charles Judson has been appointed master mechanic of the Kansas City & West Virginia, with office at Rogers, Ark.

Mr. P. Stohlberger has been appointed road foreman of engines of the Atlantic City Railroad, with office at Camden, N. J.

Mr. J. F. Cruikshank has been appointed superintendent of scales of the Southern, with offices at Washington, D. C.

Mr. W. E. Farrell has been appointed master mechanic of the Dayton, Lebanon & Cincinnati, with office at Dayton, Ohio.

Mr. W. H. Halsey has been appointed general foreman of the Chicago & North Western, with office at Missouri Valley, Ia.

Mr. C. H. Harris has been appointed master mechanic of the Changuinola Railway, with office at Bocas del Toro, Panama.

Mr. A. J. Country has been appointed president of the Susquehanna, Bloomsburg & Berwick, with offices at Philadelphia, Pa.

Mr. J. W. Sasser has been appointed superintendent of motive power of the Norfolk Southern, with office at Norfolk, Va.

Mr. Ralph G. Coburn has been appointed eastern sales manager of the Franklin Railway Supply Company, with offices at New York. Mr. Coburn is a graduate of Harvard, and had charge of the western factories of the American Glue Company. In 1909 he entered the

RALPH G. COBURN

services of the Franklin Supply Company as resident sales manager in Chicago. In 1911 he was made assistant to the vice-president in charge of the eastern-southern territory with offices in New York, which position he held until his recent appointment.

J. P. NEFF.

Mr. John P. Neff has been elected vice-president of the American Arch Company. Mr. Neff has had a notable career as a railroad man. A graduate of the mechanical engineering department of Purdue University, he entered the service of the Chicago & Northwestern as a special apprentice. In a short time he had charge of the locomotive testing plant. His promotion was rapid. His first appointment as master mechanic was at Huron, S. D., in 1901, and latterly at Boone, Iowa. In 1906 he was appointed mechanical engineer of the American Locomotive Equipment Company and succeeded to a similar position with the American Arch Company. In 1912 he was appointed assistant to the president of the company, which position he held until his election to the vice-presidency last month.

Mr. F. R. Jones has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha, at Omaha, Neb.

Mr. J. C. O'Brien has been appointed signal supervisor of the New York, New Haven & Hartford, with office at New Haven, Conn.

Mr. J. W. Neill has been appointed district master mechanic of the Saskatchewan division of the Canadian Pacific, at Moose Jaw, Sask.

Mr. G. Dempster has been appointed master mechanic of the Southern Railway Company in Mississippi, with office at Columbus, Miss.

Mr. L. W. Englehart has been appointed traveling engineer on the Minneapolis, St. Paul & Sault Ste. Marie, with office at Glenwood, Minn.

Mr. A. W. Curley has been appointed master mechanic of the Missouri Pacific, with office at Monroe, La., succeeding Mr. W. J. McKiernan.

Mr. C. H. Carman has been appointed mechanical superintendent of the Williamsville, Greenville & St. Louis, with offices at Greenville, Mo.

Mr. W. F. Aylesbury has been appointed superintendent of car service on the St. Louis Merchants' Bridge Terminal, with office at St. Louis, Mo.

Mr. G. F. Hennessey has been appointed general car and locomotive foreman of the Chicago, Milwaukee & St. Paul, with office at Marion, Ia.

Mr. C. D. Ashmore, formerly general foreman of the Chicago & North Western at Clinton, Ia., has been appointed master mechanic on the same road at Pekin, Ill.

Mr. J. G. Dole has been appointed master mechanic of the Alliance division of the Chicago, Burlington & Quincy Lines west of the Mississippi, with headquarters at Alliance, Neb.

Mr. J. Connelly has been appointed engine house foreman on the Toledo

branch of the Cincinnati, Hamilton & Dayton at Rossford, Ohio, succeeding Mr. Frank Aitken.

Mr. C. R. Foryant has been appointed Western, at Wyeville, Wis., and Mr. Sherman Witte has been appointed to a similar position on the same road, with office at Fremont, Neb.

Mr. C. F. Gesler has been appointed superintendent of machinery of the Carrolton & Worthville, with office at Carrolton, Ky.

Mr. J. E. Mourne has been appointed road foreman of engines of the Chicago, Rock Island & Pacific, with office at Manly, Ia.

Mr. I. A. Tschnor, formerly assistant master mechanic on the Baltimore & Ohio at Keyser, W. Va., has been transferred to Washington, Ind., succeeding Mr. J. J. Carey.

Mr. William Lanon has been appointed supervisor of locomotive operation of the Arkansas, Indian Territory and Louisville divisions of the Rock Island Lines, succeeding Mr. S. T. Patterson.

Mr. B. F. Crowley has been appointed supervisor of locomotive operation of the Baltimore & Ohio, with headquarters at Wheeling, W. Va., in place of Mr. T. B. Burgess, who has been transferred.

Mr. Frank McManamy has been appointed chief locomotive inspector by the Interstate Commerce Commission, with offices at Washington, D. C. He succeeds Mr. John F. Ensign, deceased.

Mr. John U. Peyton has been elected president of the Nashville, Chattanooga & St. Louis, succeeding Mr. John W. Thomas, deceased. Mr. Peyton was formerly assistant to the president of the Louisville & Nashville.

ALAN LICHTENHEIN.

Mr. Alan Lichtenhein has been appointed sales manager in Canada in connection with Franklin Railway Supply Company. Mr. Lichtenhein is a graduate of William's College and also of the Harvard Law School. His father was for many years identified with the Canadian railway supply trade, and on his death the younger Mr. Lichtenhein succeeded to his father's position. His education and experience eminently qualify him for the important and rapidly growing field of the Canadian Railway supply trade.

WALTER H. COYLE.

Mr. Walter H. Coyle has been elected second vice-president of the Franklin Railway Supply Company, in charge of sales. Mr. Coyle was occupied for a number of years on the Erie railroad in the mechanical and traffic departments. In 1905 he became identified with the Kent Manufacturing Company, Kent, Ohio, and in the same year he entered the mechanical department of the Franklin Railway Supply Company and was shortly afterwards appointed assistant to the vice-president and had charge of the sales department of the central territory.

Mr. E. B. Hall, formerly division master mechanic of the Chicago & North Western, at Chicago, Ill., has been appointed assistant to the general superintendent of motive power and car departments, with headquarters at Chicago.

Mr. S. T. Patterson has been appointed supervisor of locomotive operation of the Chicago Terminal and Illinois divisions of the Rock Island Lines, in place of Mr. R. E. Wallace, assigned to other duties.

Mr. J. J. Carey, formerly master mechanic on the Baltimore & Ohio, on the Indiana-Illinois division, at Washington, Ind., has been appointed to a similar position on the Chicago, Hamilton & Dayton, succeeding Mr. C. A. Gill.

Mr. C. A. Gill, formerly master mechanic of the Cincinnati, Hamilton & Dayton, at Ivorydale, on the Toledo division, has been transferred to Wheeling, W. Va., with title of general master mechanic of the Wheeling district.

Mr. S. Olson, formerly general shop foreman of the Oregon Short Line at Ogden, Utah, has been transferred to a similar position on the same road at Pocatello, Ida., and Mr. J. E. Stone succeeds Mr. Olson as general shop foreman at Ogden.

Mr. J. R. Coney has been appointed locomotive foreman of the Great Northern, at Casselton, N. D., and Mr. J. B. Haslet has been appointed to a similar position on the same road at Breckenridge, Minn., and Mr. O. Anderson has been appointed car foreman on the same road at Skykomish, Wash.

Mr. D. L. Grove has been appointed master mechanic of the Pennsylvania, with office at Sunbury, Pa., and Mr. W. L. Lindner has been appointed foreman of car shops at Shire Oaks, Pa. Mr. A. N. Shoup to a similar position at Cresson, Pa., and J. D. Walden to a similar position at Oil City, Pa., all on the same road.

William L. Allison has been elected one of the vice-presidents of the American Arch Company. He is a very popular railway supply man and has had an excellent training, being a graduate of the Davis Military School at Winston-Salem, N. C. He was for several years in the government service, and for six years was in the employ of the Baldwin Locomotive Works, particularly as engineer of tests. In 1904 he was appointed mechanical engineer on the Santa Fe. In 1909 he was appointed mechanical manager of the Franklin Railway Supply Company, and latterly occupied the position of Western sales manager with offices at Chicago, Ill. He was also identified with the Rome Merchant Iron Mills, and the Economy Devices Corporation and general western sales manager of the American Arch Company.

W. L. ALLISON.

Mr. F. W. Boardman has been appointed master on the Baltimore & Ohio, with offices at Philadelphia, Pa., succeeding Mr. W. D. Sennott, and Mr. M. T. Nash has been appointed general locomotive foreman on the same road at Holloway, Ohio; and Mr. G. A. Schaiffen has been appointed to a similar position on the same road at Weston, W. Va.

Mr. R. C. Hyde, formerly master mechanic of the Chicago, Rock Island & Pacific, at El Dorado, Ark., has been transferred to a similar position on the same road at Manly, Ia., in place of Mr. F. W. Williams, resigned, and Mr. W. J. Eddy, formerly inspector of tools and machinery on the same road at Chicago, Ill., has been appointed master mechanic at El Dorado, succeeding Mr. Hyde.

Mr. C. B. Randall has been appointed master mechanic of the Missouri Pacific, with office at Van Buren, Ark., and Mr. C. F. Mase has been appointed general foreman of the car department at Argenta, Ark., and Mr. J. L. Marcum has been appointed signal supervisor on the same road, with office at St. Louis, Mo., and Mr. R. R. Pollock has been appointed to a similar position on the same road at McGhee, Ark.

Mr. William Baker has been appoined road foreman of engines on the Lehigh Valley, with office at Wilkesbarre, Pa., and Mr. J. J. Keyer has been appointed to a similar position on the same road, with office at South Easton, Pa.

Mr. M. S. Montgomery has been appointed road foreman of engines of the Northern Pacific, with office at Duluth, Minn., and Mr. W. V. Wicks has been appointed to a similar position on the same road, with office at Jamestown, N. D.

Mr. William Garstang, general master car builder of the Cleveland, Chicago & St. Louis, has retired from railway service after fifty-one years continuous service in various capacities, and on many railroads, among which were machinist on the Cleveland & Erie; general foreman on the Atlantic & Great Western and the New York, Pennsylvania & Ohio; general foreman on the Pennsylvania; master mechanic on the Cleveland, Columbus, Cincinnati & Indianapolis; superintendent of motive power on the Chesapeake & Ohio, and latterly superintendent of motive power on the Big Four, and during last year served as general master car builder. Mr. Garstang is a fine type of the all-round railroad man. He was president of the American Railway Master Mechanics' Association in 1894 and 1895, and also served with distinction on many committees

Mr. Frederic A. Delano has been elected president of the Chicago, Indianapolis & Louisville, succeeding Mr. Fairfax Harrison, elected president of the Southern. Mr. Delano has had an extensive experience in railroad work and has filled almost every position in the mechanical and operating departments. Beginning as machinist's apprentice in the Burlington in 1885 he was rapidly promoted and in 1890 he was appointed superintendent of freight terminals at Chicago. In 1899 he was appointed superintendent of motive power on the same road and general manager in 1901. In 1905 he became consulting engineer to the War Department and the Philippine Commission, and in the same year was elected first vice-president of the Wabash and latterly president. At the same time he was president of the Wheeling & Lake Erie and president of the Wabash-Pittsburgh Terminal railway.

Obituary.

Lord Strathcona and Mount Royal.

One of the greatest railway builders the world has seen passed away January 21, in the death of Donald Smith, later known as Lord Strathcona and Mount Royal. Donald Smith was born in Morayshire, Scotland, in 1820, and received the ordinary parish school education. In 1838 he received an appointment as cadet of the Hudson Bay Company. For thirty years he was in the service of that corporation, and for the first thirteen of them he was employed in the wilds of Labrador. Then he was moved to the Northwest, in those days almost unexplored, and to suggest that as the commander of a Hudson Bay post he had anything but a lifetime of hard and obscure work before him would have seemed absurd. Steadily he rose, however, in the service of the company until he became chief factor and then resident Governor and Chief Commissioner of the company in Canada.

Meanwhile the Dominion itself was enlarging its boundaries. The Northwestern wastes began to receive a trickle of immigration from the East, and there ensued the Red River rebellion under Louis Riel. It was this which gave Lord Wolseley his first chance of distinction, and it was this which brought Donald Smith into prominence. The rebellion was the result of local conditions, and especially of the unfortunate position of the French Indian half-breeds before the advance of civilization, and there was no one so well fitted to deal with it as the man who had passed years as their virtual dictator. "His word," said Woolseley, "was law in all that wide region," and he aided in the speedy settlement of the difficulty.

Then Donald Smith entered the first Manitoba Legislature and was soon placed on the Northwest Territorial Council; that is, the body which administered the Northwest Territories. His next step was to enter the Parliament at Ottawa.

However, this period of his career is marked far more significantly by the great part he took in the construction of the Canadian Pacific Railway from Montreal to the Pacific Coast. In 1880 Donald Smith formed a syndicate with George Stephen. With the aid of such men as William—now Sir William—Van Horne and James Ross he triumphed over every obstacle, engineering, and financial, and in five years had the main line completed. On November 7, 1885, Donald Smith drove the last spike in a wild pass in the midst of the Rockies, and on the following June 13 Sir John A. Macdonald and his Cabinet set out from Montreal in the first train that ever ran through to Vancouver.

Donald Smith was an intimate friend of James J. Hill, and they co-operated together in pushing various Northwestern enterprises. There had been some feeling of jealousy between the two men until they met, and then they recognized in each other the masters of men and enterprises that moved them to co-operate until the end.

For the building of the Canadian Pacific Railway, the greatest of Donald Smith's achievements, he received the order of St. Michael and St. George in 1886. Next year he was elected president of the Bank of Montreal, the bulwark of Canada's finance. He began to take as prominent a position in the educational, charitable and imperial fields as he had occupied in the commercial and political.

When Sir Donald, as he had now become, went to London as High Commissioner he conferred upon that office a prestige which it had never enjoyed before. Welcome in every grade of society, a close friend of Queen Victoria and King Edward, he was raised to the peerage in 1897 on the occasion of the Diamond Jubilee. He became one of the prominent figures of official London, and was in British eyes the very embodiment of the newly-awakened imperialism. Then, in the dark days of the South African war, when this self-made Scotchman from Canada suddenly announced that at his own private charges he would assemble, equip and send out to the seat of war a body of the famous riders of the plains, he added a touch of romance to his record that insured forever his standing in British history.

A comparative stranger in the last years of his life in the Dominion, Lord Strathcona and Mount Royal was known for his hospitality to the hundreds of Canadians who had visited London.

William Thornton Henry.

Mr. William Thornton Henry, a popular sales manager of the New York Air Brake Company, died last month in his sixty-fifth year. He was a native of Ithaca, N. Y., and entered the service of the Air Brake Company 15 years ago. He was a member of a number of the best railway clubs, and was very highly esteemed by all who knew him.

Testimonial to Howard Elliott.

"We look along the line to see that all his lamps are white."

That is the inscription which appears over a testimonial which the American Association of Traveling Passenger Agents, representing the railroads of this country, Canada and Mexico, has just presented to Chairman Elliott, of the New York, New Haven and Hartford, in token of its affection and appreciation of his work as president of the Northern Pacific Railway and extending their good wishes to him as chief executive of the New Haven and New England Lines.

This testimonial is beautifully engrossed on parchment and bound in brown seal leather inscribed with Mr. Elliott's name. Accompanying it are the autographs of 137 members, representing nearly every railroad in the country and from nearly every state. The tesimonial reads:

"The American Association of Traveling Passenger Agents, representing the railroads of the United States, Canada and Mexico, hereby conveys to Mr. Howard Elliott, president of the New York, New Haven and Hartford Railroad, its sincere affection and its appreciation of his work as president of the Northern Pacific Railway, and its hearty congratulations on his recent appointment in Boston. It seems especially fitting that the city which fostered the promises of his youth should now take him back in the fulfilment of that promise. The men who knew him there in earlier days welcome him; the men who learned to respect him as an executive and love him as a friend, in the many years he spent west of the Mississippi, give him Godspeed, and the entire Association unites, with his many other friends, in wishing him a clear track and white lights the rest of his run.

"The Association derived the greatest pleasure and enjoyment from its trip through the Yellowstone National Park, September ninth to eighteenth, 1913, as the guests of the Northern Pacific Railway, and presents to Mr. Elliott its warmest thanks for having made possible this unforgettable outing a fitting finale to his western career, notable for his many acts of courtesy and kindly consideration."

New General Manager of British Railway.

The London and North-Western Railway has got a new general manager in Mr. Guy Calthorp, who was born in 1870 and joined the London and North-Western Railway in 1886 as a junior on the staff of the superintendent of the line. About eight years later he became superintendent at Crewe, and in 1901 he became assistant to Sir Frederick Harrison, then general manager. This post he occupied for a brief time, for on the retirement in 1902 of Mr. Irvine Kempt, general superintendent of the Caledonian Railway, Mr. Calthorp was appointed to the vacancy. He occupied this post until 1908, when on the death of Mr. Robert Millar, general manager, he was selected to succeed him. Two years later Mr. Calthorp resigned in order to become manager of the Buenos Ayres and Pacific Railway. This appointment, it was stated, was for a period of five years at a salary of £5,000 per annum.

Some idea of the business conducted by the London and North-Western Railway Company may be gathered when it is stated that it has almost 2,000 miles of railway, over 3,000 locomotives, about 10,000 passenger coaches, 77,000 goods waggons, over 5,000 horses, 6,000 road vans, and 16 steamboats. In addition there are about a dozen hotels.

Mr. Calthorp is a nephew of Lord Alverstone, the former Lord Chief Justice, which no doubt lubricated his upward progress.

Executive Committee Meeting.

The Executive Committee of the International Railway General Foremen's Association met at Hotel Sherman last month for the purpose of arranging for their 1914 convention, and for the consideration of other matters pertaining to the best interests of the association. The secretary had received and read very cordial letters from the Business Men's Association of numerous cities inviting the association to meet with them, notably New York and St. Louis, but after due and careful consideration it was decided that Chicago was the most suitable city to meet in due to its accessibilities and accommodations, so that the next convention will be held at Hotel Sherman, Chicago, July 14, 15, 16, 17, 1914.

The same plans will be followed as at last convention, the General Foremen meeting first, followed immediately by the Tool Foremen's convention, thus eliminating the necessity of the exhibitors moving their exhibits till both conventions are concluded.

The question of holding the 1915 convention at San Francisco during the Panama Exposition, was considered, but the committee came to the conclusion that it would not be advisable to go so far, especially at that time, for several good and sufficient reasons, so action was deferred till the next Executive Committee was elected.

Several other matters were discussed and decided upon looking towards improvement in conducting the affairs of the convention, both sociably and otherwise, and the general opinion was that the year 1914 will mark a new era in the annals of the association.

Memorial to William Murdoch.

A memorial of some kind is proposed to perpetuate the name of William Murdoch, the eminent Scottish engineer. Some eminent authorities claim him as the inventor of the locomotive, and in setting forth his qualities as an engineer it has been stated that if the whole civilized world is indebted to William Murdoch—as is now generally conceded for his application of coal gas to lighting, it is even more so for his improvements on the steam engine, particularly for its application to the purpose of transport. Recent investigations of existing documents and other existing evidence prove conclusively that he was the first to apply steam-power to mechanical locomotion in a practicable form, but he was not in a position to patent his production, and his employers not only would not help him to do so, but they did all they could to discourage him; consequently when he at length left Cornwall Richard Trevithick, who had undoubtedly seen Murdoch's steam carriage, took up the idea and constructed one on a large scale capable of carrying several persons. This was copied, and more or less improved upon, by other engineers in the North, until William Hedley and George Stephenson so far perfected it as to make it suitable for the transport of goods and passengers upon railroads as we now have them. But Murdoch showed the way, in spite of Watt's dictum that he was "hunting shadows" and that "Providence would have to work a miracle before a vehicle could propel itself."

Long Ago Promotion for Dr. Sinclair.

In the fall of 1878, the following paragraph appeared in the Iowa City *Republican*:

"Mr. Angus Sinclair, one of the ablest engineers on the Burlington, Cedar Rapids and Northen Railway, has had his headquarters transferred from Iowa City to Cedar Rapids, and will hereafter run from this point to Riverside, on the new extension. Angus is not only a skilled engineer, but he is also a gentleman of good literary ability, and has written many able and interesting articles for the press. Such men are always welcome.

"For several years Mr. Sinclair has attended the chemistry classes of the Iowa State University, having made a special study of water analysis. He will act as chemist for the Burlington, Cedar Rapids & Northern Railway so far as the selection of water for boilers is concerned.'

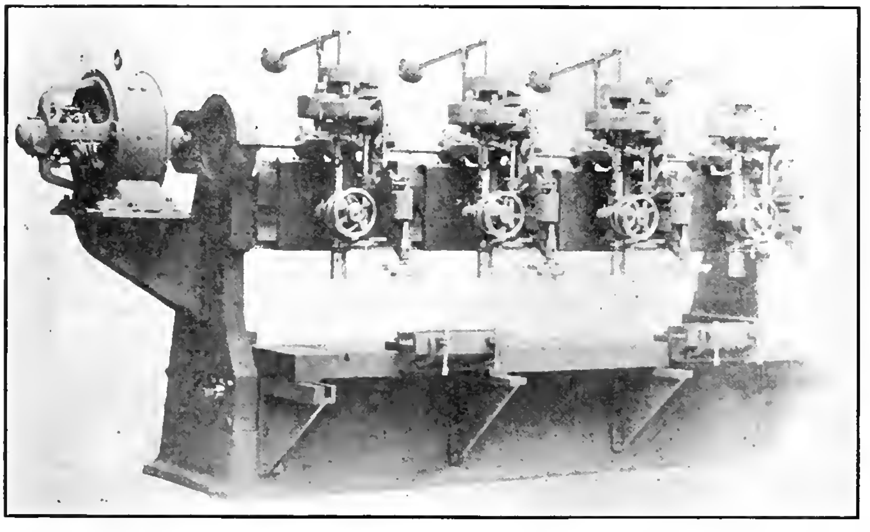
Secretary Taylor's Office Moved.

The office of Secretary Taylor, of the Master Car Builders', and of the Master Mechanics' Association, has been moved to 1112 Karpen Building, Chicago, Ill.

Motor-Driven Mud-Ring and Flue Sheet Drill.

The value of motor drive for machine tools is rapidly being realized. The illustration shows a Foote-Burt 4-spindle drill installed in the Juniata shops of the Pennsylvania Railroad, where it is used for drilling the rivet holes around fire box mud-rings and the flue holes in boiler flue sheets. The motor, of 20 horsepower, is of Westinghouse make and is geared direct to the drive shaft by a large spur gear and a rawhide pinion. It has a speed adjustment of from 375 to 1,500 r. p. m.

Some idea of the size of this machine is obtained from the following: The heads have an adjustment in and out of 12 inches, and are adjustable on the main rail up to a minimum centre distance of 18 inches. The heads carrying the spindles are complete in themselves, as each is arranged with a clutch for stopping and starting. Adjustable stops for automatically knocking off same are provided. Two changes of power feed are provided on each head.



MOTOR-DRIVEN MUD-RING AND FLUE SHEET DRILL.

The base is a continuous box section and the table is arranged for an in and out motion of 36 inches. The total weight is 23,000 pounds.

Recommended Practice of the New York Air Brake Co.

On account of the numerous cases of wrongly used triple valves, auxiliary reservoirs and sometimes brake cylinders that have come to our notice, we print herewith a table showing the correct use of the parts in question, and in addition, proper sizes for supplementary reservoirs in passenger service as well as some information calculated to be of value to repairmen and inspectors who come in touch with these equipments.

The following table shows the area of, and force exerted by, the different brake cylinders, and has been repeatedly proved by experiment:

Diameter of cylinder.	Area of cylinder.	Force exerted at 50 lbs. per. square inch.
6″	28.27	1,400
8″	50.27	2,500
10″	78.54	3,950
12″	113.10	5,650
14″	153.94	7,700
16″	201.06	10,050
18″	254.47	12,720

BRAKE PIPE PRESSURES.

Unless local conditions of service render a change from the following necessary, the recommended pressures will be as follows:

Minimum brake pipe pressure for general freight service, 80 pounds; for freight train service on heavy grades, 90 to 110 pounds; for switch engines in general freight yard service, 70 pounds; for switch engines in general passenger yard service, 110 pounds; for passenger car service without high speed appartus, 90 pounds; for passenger car service with high speed apparatus, 110 pounds.

A Huge Rudder.

A rudder is an attachment to a ship which is moved by the helm and regulates the direction in which the vessel is required to go. In small ships and boats the rudder is little more than a pear shaped board. The immense increase in the size of modern steamships may be judged by the fact that a rudder with a doorway into the interior is a striking feature of the Cunard liner *Aquitania* The rudder has just been placed in position, and is so large that a doorway has been constructed in the lower part to admit workmen so that they can remove the pin which connects the rudder to the ship. This pin is four feet in length and bigger than the heaviest projectile made for modern artillery. When delivered at the builders' yard the rudder was in three parts. After they had been connected and laid upon the ground the distance to be walked to pass round it was over 100 feet.

Encourage Irish Lace Makers.

It is now considered the proper thing among tourists and visitors to Ireland to bring home a supply of Irish lace which is made very artistically by the lowly maidens of the Green Isle. The people who purchase this lace are encouraging a worthy industry. Bring a good supply next time you come over.

Irish lace, which is making a brave fight with the machine-made article, originated from the failure of the potato crop that caused the famine of 1846. The abbess of a convent in County Cork, looking about for some lucrative employment to help the half-starved children who attended her schools, unravelled thread by thread a scrap of point de Milan, and finally mastered the complicated details. She then selected the girls who were quickest at needlework, and taught them what she had painfully learned. The new industry prospered, and one of the pupils, in a pardonable "bull," declared that "if it had not been for the famine we would all have been starved."

Where Laws Are Enforced.

Among my acquaintances I count a most interesting and intelligent Chinese. The other day we were talking about laws, their enforcement, etc. I happened to mention our so-called "anti-trust law." He said they had one in China also and that it was so short he could recite it for me, which he straightway did as follows: "Those who deal with merchants unfairly shall be beheaded. Those who interrupt commerce shall be beheaded. Those who attempt to close the markets shall be beheaded. Those who maintain the prosperity of commerce shall be rewarded."

He added, naively, that in his country the anti-trust law seldom was violated a second time by the same person. He said this law was strictly enforced throughout China and that he had noticed the penalty for its violation usually made the violator scrupulously law-abiding in every particular thereafter. This "good Indian" method of law enforcement in China might be considered a bit harsh here, but isn't it beautifully effective?

Bulgarian Railways

Upon the conclusion of the large foreign loan which the Bulgarian Government is negotiating, the Director of Railways and Ports will call for tenders for railway equipment and supplies, which would appear to offer an opportunity for profitable participation by American firms. These tenders will call for the delivery of 20 locomotives and 800 freight cars. A large amount of rails, turning bridges, and general equipment for the national railway lines will also be purchased. Copy of the complete report, giving further details, may be obtained from the Bureau of Foreign and Domestic Commerce.

RAILROAD NOTES.

The Wabash is in the market for 60 locomotives of various types.

The Gainesville & Northwestern has ordered a 10-wheel locomotive from the Baldwin Locomotive Works.

The Kanawha & Michigan has ordered 5 steel coaches from the American Car & Foundry Company.

The Fort Worth Belt has ordered one 6-wheel switching locomotive from the American Locomotive Company.

The Atlantic Coast Line, it is said, will make improvements and erect additional shop buildings at Waycross, Ga.

The Texas, Oklahoma & Eastern has ordered 2 freight locomotives from the American Locomotive Company.

The Chicago & North Western has placed an order for 35,000 tons of steel rails with the Illinois Steel Company.

The New England Coal & Coke Company, it is said, has ordered 200 hopper cars from the Pressed Steel Car Company.

Plans have been completed by the Lackawanna, for the construction of 14 freight locomotives of the Pacific type and 4 passenger engines of the same type.

The Northwestern Pacific has ordered four 9-wheel 77-ton passenger locomotives and two 10-wheel 90-ton passenger locomotives from the American Locomotive Company.

The Illinois Central is building a complete engine and car repair terminal at Noncorinah, Tenn., at a cost of $600,000. George B. Swift & Co., of Chicago, has the contract.

Foundations have been completed for the erection of the Baldwin Locomotive Works' plant at Calumet, near Gary, Ind. The shops will cover sixteen acres and will employ 10,000 men.

The Atchison, Topeka & Santa Fe has ordered 500 box and 300 furniture cars from the American Car & Foundry Company. This road has also ordered 200 tank cars from the Pressed Steel Car Company.

The Lackawanna has placed an order for 5,000 tons of steel rails with the Pennsylvania Steel Company. The total order was for 15,000 tons and was divided between Pennsylvania Steel, Lackawanna Steel and Bethlehem.

Bids are being received by the Pennsylvania for a steel bridge over the Delaware river at Trenton, N. J., to have six spans and to carry two tracks. This road has contracted with the Lackawanna Bridge Company for 300 tons of steel for two bridges.

The Pittsburg & Lake Erie is making improvements above McKeesport, Pa., on which $150,000 has been spent, with the work not half done. Yards or shops may occupy the 47 acres of ground purchased by the company about a year ago.

It is rumored that the Chicago, Milwaukee & St. Paul is considering the proposition of consolidating its shops now located at Savanna, Ill., and Ottumwa, Ia., and putting the shops at one place. It is rumored that they will be located at East Moline, Ill.

The Cumberland Valley has placed with the American Car and Foundry Company an order for 13 seventy-foot passenger coaches and three seventy-foot combination passenger and baggage cars. The construction of these cars will conform to the standards of the all-steel equipment of the Pennsylvania Railroad.

The Pullman Company has established a pension plan providing for the retirement of employees at the age of 70 or after 20 years of service in case of disability with a pension equal to one per cent for each year of service of the average rate of pay for the last year of service. No one over 45 years of age will be taken into service hereafter except by special arrangement.

The Louisville & Nashville plans for 1914 call for 200 miles of automatic block, 131 miles of double track and the balance of single track. New power interlocking plants will be installed at Athens, Ga., Mayton, Tenn., and at the Cumberland river bridge, while manual interlocking plants will be at Mobile, East St. Louis and French Village, Ill., and Lewisburg, Easton, Maplewood and Knoxville, Tenn.

The memory of the late J. T. Harahan, president of the Illinois Central Railroad, is being perpetuated by the construction of a heavy bridge across the Mississippi River from Memphis to Arkansas. The bridge is being constructed by the Rock Island, the Missouri Pacific and the Cotton Belt roads. It will be a double-track structure of cantilever design, and will furnish two roadways for wagon and automobile traffic as well as additional railroad facilities. Ralph Modjeska of Chicago is the engineer in charge. The J. T. Harahan bridge, as it will be termed, will be 75 feet above the high water mark of 1887, and longest span 790 feet.

Accurate Knowledge at a Discount.

Accurate knowledge is by no means common among those who are engaged in acquiring knowledge, and it hangs very loosely among those whose school days are over. Hamlet is one of Shakespeare's best known plays, but even well educated people who seldom go to theatre may be excused for blundering about the author.

One day an inspector examining the pupils of an English high school, finding the children dull, suddenly and severely asked a class of grown boys, "Who wrote Hamlet?" Consternation reigned for a time, then a boy stood up and said in a trembling voice, "It wasn't me." The story was told to an English lady, who listened with attention, and finally remarked, "H'm; I'll be bound that was the very boy who did it." The new story, now double-barrelled, was told to a second lady, who replied, "That's all very well; but, after all, we haven't been told who did it."

Patrick Henry's Fee.

It is said of Patrick Henry that during his practice of law in the Virginia courts, and when he was familiarly addressed as "Governor," a man who had been arrested for stealing a hog, and who was out on bail, went to the Governor to have him defend him.

The Governor said: "Did you walk away with that shoat?"

"I don't like to say."

"Out with it."

"Yes, sir."

"Have you got the carcass?"

"Yes, sir."

"You go home, you wretch; cut the pig lengthwise in half and hang as much of it in my smoke house as you keep in yours."

At court the Governor said: "Your Honor, this man has no more of that stolen shoat than I have."

The man was cleared.

A Hantle Quicker.

When Sir John Millais was painting "Chill October" among the reeds and rushes of the Tay one afternoon a voice from behind a hedge asked, "Man, did you ever try photography?" "No, never," said Sir John, and he continued to paint slowly. "It's a hantle quicker," said the voice. "Yes, I suppose so," the painter agreed. Then the voice said bitingly, "An' it's mair like the place."

A Squealer.

"What are you here for?" I enquired of a colored man in jail at Cleveland, O. "Stealing a pig, sah." "But you know better now than to steal?" "I know better next time, sah. I won't steal nuffin' dat will squeal on me."

The Poet Burns the Craftsman.

The celebrated Scottish poet Robert Burns, the anniversary of whose birth was celebrated by millions of the poet's admirers all over the world last month, was of the farmer class, but he delighted to call himself as a plowman, and as a plowman he became known to fame. Class prejudice runs fiercely in the British Isles and thousands who would have respected Burns the farmer, had no use for Burns the plowman. Burns was proud of his skill as a craftsman and in declaring his spirit of independence informed the world that he needed no one's help because he could plow. This is a spirit well worthy of imitation by those whose industry and perseverence have made them the master of a trade that keeps them independent.

Notes.

It is interesting to note that 61,000 workers are now employed on the South African Railways, as compared with 43,000 in 1909. In 1910 the present Administration took over 7,692 miles of working lines; in 1912 it worked 8,501 miles of line, its trains running 28,000,000 miles, compared with 19,500,000 miles in 1909. The Union Railways serve an area of about 472,730 square miles, an area nearly four times the size of Scotland, Ireland and England together.

The new harbor at Emden, Germany, which has taken three years to build, was opened recently with a good deal of ceremony. The sea sluice of the Emden harbor is the largest in the world; it is 260 meters long, 40 wide and 13 deep. Sixteen torpedo boats can pass through simultaneously within 15 minutes.

That sawdust and other mill waste can be profitably manufactured into briquettes for fuel is evident from the fact that a large lumber company in British Columbia is erecting a $50,000 plant, which will have a daily output of about 30 tons of such briquettes. They will sell for about five dollars a ton at the mill.

It is a remarkable fact that the British possessions, including Egypt, had 117,449 miles of railway, equal to nearly 18 per cent. of the world's mileage, and if the United States were added the mileage in the English speaking countries would be 453,635 miles, equal to a little over 69 per cent. of the world's mileage.

Find what a man enjoys, what he laughs at, what he calls diversion, and you know what he is.

Be not afraid of life. Believe that life is worth living, and your belief will help create the fact.

Books, Bulletins, Catalogues, Etc.

Funk & Wagnalls Standard Dictionary.

One of the first aids that a person ambitious to acquire knowledge should provide himself with is a first-class dictionary. A dictionary is generally regarded as a passive reference to be used when the necessity arises, but a person with proper ideas concerning the acquisition of knowledge will systematically make opportunities for the dictionary proving its worth.

These remarks are suggested by the receipt of a splendid copy of Funk and Wagnalls new Standard Dictionary, which seems to be a complete storehouse of general and technical knowledge. It would be difficult to conceive of any line of information that this admirable book would fail to supply. We have been in the habit of consulting a variety of hand books for all sorts of useful information that cannot well be carried in the head, but this dictionary will send most of our hand books to the shelf, for it seems to contain all facts known concerning applied mechanics, history, biography, geography and other useful knowledge too comprehensive to give details. Where reading description is not sufficient to render any article or device comprehensible, excellent illustrations are used to aid the text.

The writer has found dictionaries a valuable medium of education and notes of his experience may be of value to others who are trying to climb the steep grade of self-help. Like many other young mechanics, he left school with a very indifferent education to begin work. He was fond of reading and frequently came across words which he did not understand. One day he found the word "opprobrium" in a book he was reading. Not knowing what it meant he noted it upon a slip of paper with the idea of consulting a dictionary when he got home. Then the suggestion came to carry a memorandum book for noting down words he did not understand and the practice was followed for years and resulted in his acquiring a most comprehensive vocabulary. If our readers who have access to Funk and Wagnalls new Standard Dictionary will adopt the practice described they will acquire an immense fund of useful knowledge obtained in connection with words looked up.

There is so much useful information imparted with many words in this dictionary, that looking them up becomes a useful course of education. So many people with defective educations work their way into important positions that self education becomes important. Those suffering from the effects of this shortcoming cannot do better than call this dictionary to their assistance. If they read books words will constantly be encountered that call for plain definitions when the dictionary offers a ready and effectual aid. Take our advice and make it of thorough service.

Whither Drifting?

The above is the title of an address recently delivered by Mr. Alba B. Johnson at a meeting of a New England Society. The address is a remarkable sound exposition of honest business principles that it ought to be read by every person interested in the business carried on by people in the United States. It will prove a certain antidote to the poisonous heresies concerning our business methods that are being constantly scattered wide spread among our people.

Railway Supply Men.

The Railway Supply Manufacturers Association, of which Mr. B. A. Hegeman is president and Mr. J. D. Conway secretary, has sent out a circular relating to the conventions of the Master Car Builders and American Railway Master Mechanics Associations to be held in Atlantic City in June. The circular requests that persons or companies desiring space for exhibits will make the application not later than February 14. Application should be made to J. D. Conway, 630 Oliver Building, Pittsburgh, Pa.

Proceedings of the Railway Master Mechanics' Association.

The report of the Proceedings of the Forty-sixth Annual Convention of the American Railway Master Mechanics' Association held at Atlantic City, N. J., last June is just issued from the press of the Henry O. Shephard Company, Chicago, Ill., and forms a bulky volume of 661 pages, in addition to which there are 192 pages, with numerous folders, devoted to a complete description of the locomotive testing plant at Altoona, Pa. This important addition presents a series of tests of a class F 6 S passenger locomotive, and is in itself an important addition to the railway literature of our time. The bulk of the volume is devoted to a complete report of the various papers presented and the discussions that followed. The numerous illustrations that accompany the text are excellent and the volume as a whole is the best reflex that has yet been presented of the work of this important association. It should be in the hands of all of the leading men in the mechanical department of railways, as it presents in concrete form the best expression of the best thoughts of the railway men of our time. The typography and binding are excellent, and the illustrations, as we have said, are of the best.

Report of the Proceedings of the Master Car Builders' Association.

The marked increase of the work of this association has necessitated the publication of two volumes containing the complete report of the various papers and debates on the same that were presented before the forty-seventh annual convention of the Master Car Builders' Association held at Atlantic City, N. J., in June of last year. Part I contains 666 pages and Part II nearly as many with a large number of folders showing details of car construction, the great bulk of which is published in book form for the first time. A marked feature is the complete reports of the various discussions that arose on the presentation of the numerous papers. It would be hard indeed to overestimate the importance of these discussions, coming, as they do, from men of such wide experience in the modern appliances used in railroad rolling stock. It will be readily observed by those who have made themselves familiar with the work of this association that there is a marked improvement each year in the grasp of the subjects and their comprehensive treatment. The publications are of the highest value to all engaged in railroad car construction. The printing and binding are of the usual fine type of the Henry O. Shepherd Company, Chicago, Ill.

First Aid.

The American Red Cross abridged text book on First Aid, railroad edition, being a manual of instruction, by Major Charles Lynch, of the medical corps of the United States Army, has just been published by P. Blakiston's Sons & Co., 1012 Walnut street, Philadelphia, Pa., and bids fair to furnish exact instructions in a very handy and cheap form in regard to every conceivable kind of accident occurring on railroads. Major Lynch has had exceptional experience and has had works on the same subject published already which have had an extensive sale among miners and those engaged in industrial work of various kinds. In providing separate books for special classes, both author and publishers have acted wisely, and in the work before us there is furnished what must prove to be of great practical worth to railroad men. The work extends to 150 pages, with numerous illustrations, bound in flexible covers, and is sold at 30 cents, net.

Workmen's Compensation Law.

Mr. William H. Hotchkiss, former Superintendent of Insurance of New York, has written an analysis of New York's New Workmen's Compensation Law for employers and employees. The Publicity Bureau, under the management of Mr. Robert H. Fuller, of the Merchants' Association of New York, are furnishing copies of the pamphlet to all of the members of the association, and we are hopeful that the association will find means to give the work a still wider circulation. The pamphlet presents in a brief form all the salient features of the new law, and also a review of the various Workmen's Compensation bills which have been introduced in the Legislature from time to time.

Increased Railroad Rates.

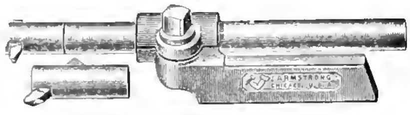
Among the mass of published addresses, pamphlets and other matter in relation to the demand for increased railroad rates, Mr. J. L. Minnis, attorney for the Central Freight Association Lines, has just filed with the Interstate Commerce Commission a digest of the evidence submitted by Mr. W. C. Maxwell, on behalf of the companies. The matter is now published as Bulletin No. 17, and in point of convincing logic it is a masterly document of its kind, and arrays in brief a history of the railroads interested since the operation of the Interstate regulations. The decrease in dividends is appalling, and may be epitomized in the statement that only nine companies out of twenty-eight in a certain group have paid dividends last year. It is evident that with the growing disasters, unless a change comes soon, American railroads, generally speaking, will cease to meet expenses.

Heating, Chilling and Die Presses.

Catalogue No. 89 has just been issued by the Watson-Stillman Company, 50 Church street, New York, describing and illustrating their new and improved heating, chilling and die presses. The continued growth of the company's works at Aldene, N. J., is the best proof of the growing popularity of the company's fine products. Their chilling presses have reached a degree of perfection that insures uniform working pressures in every variety of work. The same may be said of the heating presses and die and die-sinking presses. To these may be added the yoke cylinder press and multiplate press. Among others are the 4,000-ton press which is used for the manufacture of composition sheets, and which is accomplishing work hitherto unapproached in press work. Copies of the interesting, finely illustrated catalogue may be had on application.

An illustrated catalogue of 50 pages, Bulletin may be had on application to the assistant of the president of the American quarters at Miami, Fla.

A man's deeds attract more attention than his creeds.



Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, March, 1914. No. 3

Improvements on the Union Pacific Railroad

Our frontispiece illustration this month gives some idea of the important improvements that have recently been made in the Union Pacific Railroad. The cut shown is one of the largest in the world. It is located a short distance west of Omaha, Nebraska. Its construction shortens the distance by nearly 9 miles. The portion shown in the illustration is 85 feet deep, 437 feet wide and extends 5,200 feet in length. The entire cut-off is nearly 12 miles in length and is altogether a remarkable feat of railroad engineering. The whole distance is almost taken up in cuts and fills, and it has been constructed contrary to the usual course of following waterways and other natural courses. The cost of the work on the distance alluded to exceeded $3,000,000. The double track portion as shown in the excavation portion is 29 feet wide, the single track being 16 feet wide. The railroad is largely ballasted with what is known as Sherman gravel, a form of decomposed granite which is obtained from an immense pit near the summit of Sherman Hill at Buford, Wyoming. The depth of the ballast is 15 inches. The ties are 8 feet in length, and the granite ballasting extends to a distance of 6 inches beyond the ends of the ties. There are eighteen ties under every 33-foot rail. Steel tie plates, 8 inches square and 7/16 of an inch thick are inserted under both rails on every tie. The spikes which fasten the rails to the ties pass through holes in the tie plates, thus assisting in preventing the track from spreading, and a shoulder on the outer edge of each plate acts as a further preventative of the evil.

UNION PACIFIC LANE CUT-OFF, LOOKING WEST OUT OF THE BIG CUT, NEAR OMAHA, NEBRASKA.

The steel rails used on the Union Pacific main line weigh from 80 to 90 pounds per yard and are of the best quality obtainable. The rail joints are alternated, each joint on one side of the track being opposite the center of a rail on the other side. Two ties are used under every

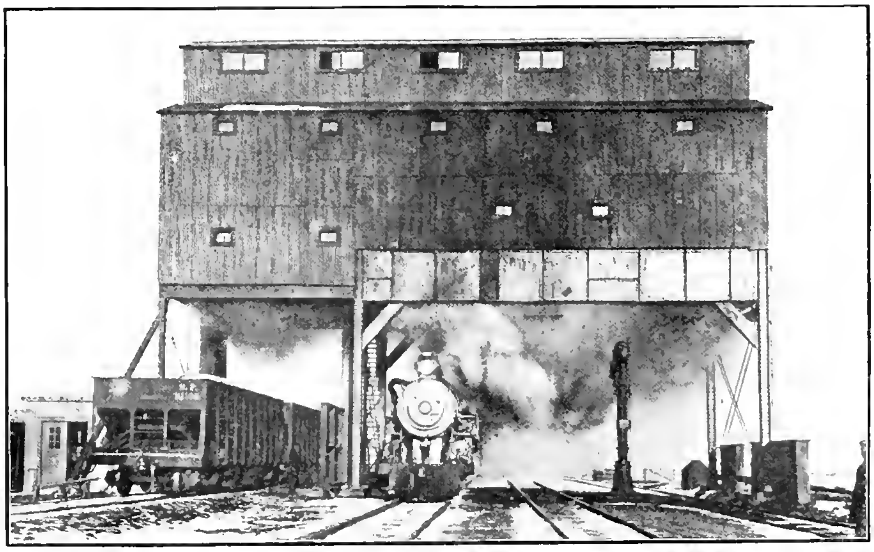
joint, forming what is known as a suspended joint, which tends to strengthen it and, at the same time, leave it sufficiently flexible to allow the wheels to glide over it easily and without shock or jar.

The operation of the signals used on the road is entirely automatic. An electric current flowing through the rails of the track holds the signal in the clear position as long as the block is clear. A train, open switch or a broken rail interrupts the current, thereby releasing the electric clutch which is holding the signal clear, and the arm immediately moves to the danger position. When the block is again clear, the signal is restored to the clear position by a small electric motor.

The fact has been clearly demonstrated that a train under the protection of automatic electric signals travels in a zone of safety. Signals are set at danger for a mile or more in advance and remain in that position until the train has passed that distance ahead, thus creating, to all intents and purposes, an impenetrable shield which moves along at all times with the train safely within its influence.

The coaling station shown is of the all-steel conveyor type of coal and water station of 440 tons capacity, and is adapted for serving three tracks. Coal is dumped into a steel track hopper and delivered to a roll type crusher by a reciprocating feeder. The crusher reduces mine-run coal to about 6-inch cubes and discharges to a gravity elevator conveyor of an average capacity of from 60 to 90 tons per hour. This conveyor in turn delivers crushed coal to three 80-ton capacity overhead storage bins equipped with scales and recording beams. Each bin is also equipped with under-cut gates and chutes for delivering coal to locomotives. Machinery is driven by a distillate engine through rope drives.

The water columns are so located with reference to coal chutes that when a locomotive stops for water, coal may also be taken simultaneously.



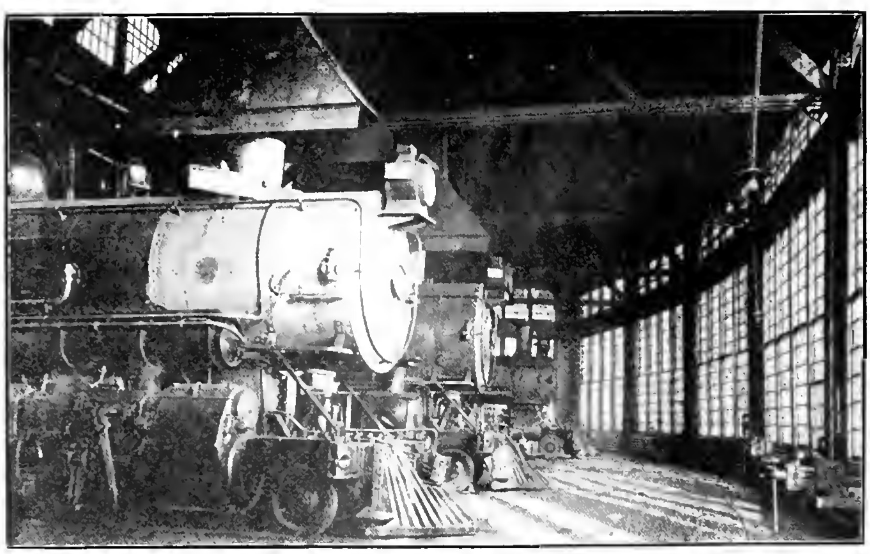
UNION PACIFIC COALING STATION, OGALLALA, NEB.

The illustration showing the interior of the roundhouse at Cheyenne, Wyo., is one of the latest additions to the roundhouses along the road. It is a 96-foot brick structure equipped with every modern appliance, including steam heat, electric lights, boiler blow-off and washout systems and transit smoke jacks. The roof is of saw-tooth timber construction, permitting a maximum of light and ventilation.

The last illustration is a view of what is known as the Limited train on the main line of the Union Pacific. The main line extends from Omaha to Ogden, Utah, 1,011 miles, and from Kansas City, Mo., to Colett Junction, Wyo., 739 miles, besides numerous branches in Kansas, Nebraska, Wyoming, Utah and Colorado, making a total roadway owned by Union Pacific of 3,548 miles. In addition to this the Oregon Short Line, extending to 960 miles, the Oregon-Washington Railroad & Navigation Company, 823 miles, and other lesser lines and branches of lines are owned and operated by the Union Pacific and together comprise 7,504 miles of track, with 1,691 locomotives and 37,929 cars.

The recent additions to the rolling stock equipment are of the best and, as we have already stated, the signalling equipment is in the forefront of that special department of work. This is particularly noticeable at Omaha, where hundreds of trains a day are run over the stretch of tracks between Council Bluffs and Summit, where the new cut-off, which we have described, branches off from the old line of the Union Pacific. These tracks are used not only by the numerous trains of the Union Pacific, but also by the North Western, the Milwaukee, the Rock Island, the Missouri Pacific, the Chicago Great Western, the Illinois Central and over the bridge section of this strip are run trains of the Wabash and the Burlington.

Handling these trains through the yards, or to be more exact, over the miles of track that stretch between the eastern limits of Omaha, is accomplished with absolute safety and certainty, and without delay, by means of an elaborate system of interlocking switches, controlled by operators stationed in towers from which the movements of the trains and the designation of the tracks on which they are to run is made with mathematical certainty and mechanical accuracy. The presence of the Union Pacific bridge and its long approach from the Iowa side complicates the local problem to some extent, for it makes a necessarily congested district of extreme importance in the very middle of the great switching yards. But in the towers at the Council Bluffs transfer station and at the Omaha Union station is established the control of all these matters, and long before the train is in sight at either depot the operator has taken it under control and has set the switches that will let it in on the designated track. T[illegible] eer proceeds with confidence, fo[illegible] ell aware that at any point along [illegible] where he en-



UNION PACIFIC ROUNDHOUSE, CHEYENNE, WYO.

ters a danger zone he will be notified by an unfailing signal, and that so long as this does not flash on him he has a straight way into the station. It may be the way will lead him across many switches and crossings and through puzzles that seem inextricable; but the switches have been set by mechanism that is unerring, and collision is impossible, for once that the operator has set a combination of switches he can not add another to it without first breaking the whole.

In the switch tower the operator has a large map of the yards, with each track numbered and each switch designated. He gets from the yard foreman, or the depot master, the number of the track into which the approaching train is to be shunted, and the levers are pulled, the devices that actuate the points are set in motion by electricity, the operation is complete and the train proceeds safely. At the switch points a series of levers, driven by an electric motor, moves the switches. Nothing could be more simple or more certain. The operator knows when the train is to go, the engineer knows that the operator knows and the time is preserved that would otherwise be wasted in sending a man ahead of each incoming train to set switches and otherwise prepare the way. Old-time enginemen will understand what an advantage this is, for they can recall how much they had to trust to luck as they sped with heavy trains through great switch yards, where the main line was more or less of a myth and where the element of human fallibility entered largely into the problem. The interlocking switch eliminates the human factor and the engineer now proceeds with perfect faith in the simple mechanical device that controls the switches.

Recent years have seen the rapid introduction of this admirable system of block signalling and switch controlling, but nowhere are these devices in more perfect operation than they are in the extensive yards at Omaha, or on the tracks of the Union Pacific.


TRAIN NO. 18, UNION PACIFIC, NEAR KEARNEY, NEB.

First American Railroad.

In 1826 Maryland granted the first charter to a railway company in America authorizing the organizers to carry on a business of transportation. That was the Baltimore & Ohio Railroad, which all through the succeeding years maintained a prominent place among the railroads of the country. The idea of the promoters was that this railroad would be operated by horses and that the farmers along the right of way would do the operating.

The well known philanthropist Peter Cooper, who was then a merchant in Baltimore, perceived a much greater future for the railroad. At his own expense he designed and built a small locomotive, which he called the Tom Thumb by which he demonstrated that the new line could be operated by steam. The engine was a very tiny machine, with upright boiler and a single cylinder 3½ x 13½ inches, but it did the work of hauling a loaded car and banished the idea of operating by horses. It also proved how competent American business men were of wrestling with the most difficult mechanical problems.

Russian Railway Mines and Shops.

Secretary of Embassy Charles S. Wilson, at St. Petersburg, calls attention to the intention of the Russian Ministry of Ways of Communication to ask the Duma for an appropriation of $1,133,000 for the purchase of coal mines to be operated by the State railways. An appropriation of $40,000,000 is also sought for the repair shops of the Government railways, which will make them virtually large locomotive and car works.

Professor Hadley on Train Speed.

A public statement of Professor Hadley makes out that the speed of railway trains is restricted within three theoretical limits: "First, a physical limit of 80 miles an hour, beyond which it is found impossible for a train to hold the track; second, an operating limit of 60 miles an hour, which practical experience has found trains cannot run, without much damage to life; third, a commercial limit of 30 miles an hour, at which, all things considered, it is found most economical to run a train."

All of which moves us to say that it is a pity Professor Hadley did not try to learn something about practical train running before he ventured to open his mouth as an authority on the subject.

Plodding.

It is well to remember that there is a multitude of things, and among them many that are not worth doing, that can never be accomplished save by plain, straightforward, everyday, persistent plodding. It is all right to start the enterprise with a great flourish of trumpets, but that does not get you along very far with it. Before it is finished, if it is to be worth anything at all, some one has to get down to plain plodding. There is always a stretch of hard road in any bit worth while adventuring, no matter of what kind it is. Nothing is ever all brass bands and banners. Brilliancy and enthusiasm are good, but there is a homely old virtue that accomplishes very much more than either of them. See that you do not despise it.

The British Weights and Measures.

There is some unrest among British people about the weights and measures in use, some enthusiasts doing their best to push the metric system into popular favor. That is an uphill fight for the existing system enjoys the force of long antiquity.

The avoirdupois pound was adopted as a commercial standard by a statute of Edward I. in 1303; it was divided into 16 ounces and 7,000 troy grains. From this origin the English pound has descended in substantial integrity to the present time, and such changes as have been made have been due to the restoration of standards and have been of a minute and unavoidable character. In 1582 the 56-pound weight of Edward III. was adopted as the standard for avoirdupois weight, and it is from this standard that the cwt. of 112-pound was most probably derived. There have been few changes in the measures of length from the times of the Saxons, and the earliest surviving standard varies scarcely more than a hundredth of an inch from the present Imperial yard.

General Correspondence

Machinists' Wages in the South.

EDITOR:

In an article by Mr. W. Richardson, published in your January issue, quite a cry is raised about the working conditions of railway machinists. I notice that his views are also voiced by Messrs. John Reardon and E. W. Thomson in the February issue.

It is not my intention to prove that their statements are untrue, so far as they go, nor, to argue the "ancient" question as to whether or no machinists reap the full benefits of their labor, I merely wish to suggest that they be more specific as to the locations of cited conditions.

RAILWAY AND LOCOMOTIVE ENGINEERING is read by numbers of people who are not familiar with local conditions and get the impression that Mr. Richardson's statements hold good all over the country. I notice that all three correspondents are "up North" and are apparently not familiar with conditions "down South." For their information allow me to state that machinists on this system receive a flat rate of 40 cents per hour, time and one half, or 60 cents for all overtime and holidays. Men working on piece work (only at main shops) limited to 60 cents per hour, half-hour shop time added for overtime.

Nine hours constitute a day. Instead of the brutal practice of closing up the shop for days, or even weeks, a more sane method of reducing expenses is employed, which is as follows:

"When it becomes necessary to reduce expenses the full force of men will be retained and reductions made in time until eight (8) hours per day is reached, except at Roanoke and Portsmouth main shops, where 40 hours per week will be observed. Should a further reduction become necessary the force may be reduced, the last man employed being the first laid off. As the needs require those laid off will be given preference of re-employment," etc.

For Mr. Reardon's information I will say that we have adopted a policy to exclude the pretended machinists; and a non-union man—well, he don't stand much chance here.

In conclusion will say that by working one Sunday we can all average $100 per month, which enables us to live comfortably with a little left for amusements, and firm determination to settle all disputes by arbitration and otherwise promote harmony in the shop leaves very little to be complained of.

If Mr. Richardson would devote his time to improving conditions, as we did ours, and not complain so much he would profit more thereby.

W. T. KEARSLEY.

Bluefield, W. Va.

Model of American Type Locomotive.

EDITOR:

Herewith a photograph of model American type locomotive, designed and built by the undersigned.

Locomotive, 32 ins. long, 9 ins. high, 4 ins. wide; guage of tracks, 2 ins.; boiler, built of heavy brass tubing, 1/32 ins. thick; carries 10 lbs. steam; equipped with electric head light, operated by battery in baggage car. Driving wheel, 3 ins. diameter; 1½ oz. counter balance in each; wheel stroke, 1⅛ ins.; diameter of cylinder, ⅝ in.; piston valve, and Stephenson link motion, equipped with superheater, lubricator, injector, 2 gauge cocks, water glass, whistle, safety valve, bell water glass, correctly modeled reverse lever and throttle valve. Capacity of boiler, 1 quart of water; fuel, alcohol in four of blow torch; one big flue through center of boiler; tender carries 1½ quarts water and 4 ozs. alcohol; weight of engine under steam, 30 lbs; will run 1½ hours without renewing fuel or water, with a draw bar pull of 70 lbs. on the level; takes a curve of 14 ft. radius.

AMERICAN LOCOMOTIVE MODEL.

Engine is No. 3, class R1, North and South R. R.

G. E. BRINK,
Mechanical Engineer.

Sterling, N. J.

The Southern Locomotive Valve Gear.

EDITOR:

The new valve gear for the Southern Railway locomotives illustrated in RAILWAY AND LOCOMOTIVE ENGINEERING, February issue, is really old.

About three decades ago Mr. George S. Strong, of New York, designed and had built the locomotive "Duplex," No. 444, which was tried on the Lehigh Valley Railroad. This engine had the same valve gear as the new gear on the Southern Railway, with the addition of another sector, bell crank and eccentric-rod for the exhaust valves, all driven by one eccentric.

Evidently Mr. Strong was ahead of the times as this engine and others of his design had trailing wheels under the firebox which is very common to-day but was then considered as being an undesirable increase in the dead weight of engine.

F. HOCHBRUNN.

New York, N. Y.

Safety and Efficiency.

EDITOR:

In order to increase the standard of efficiency railroads have spent millions of dollars in automatic danger signals, air brakes, interlocking and block devices, automatic couplers and similar safety appliances; have put in effect Interstate and State laws and rules regulating the operation of trains and the use of machinery, yet after all is said and done we are in a measure thrown back on ourselves because the dominant factor in safety and efficiency is and always will be the fallibility of mankind.

If men could be made perfect, as well balanced and easily controlled as machinery, there would be little, if any, necessity for safety and efficiency committees. Such however cannot be and it therefore behooves every man, as far as practicable, to safeguard himself against his own shortcomings.

From the President of a railroad to the section hand and laborer, each and every man has a duty to perform to his fellow employee, himself and the public. When we realize how far reaching are the acts of even the lowest railroad employee, it is amazing that statistics do not show a larger number of fatal railroad accidents.

The Section Foreman, Road Master, Shop and other Foremen, Traveling Engineer and Train Master who by lax discipline, invite careless work; who trust to others for information instead of personally satisfying themselves of the safety of that which they are directly or indirectly responsible for, are equally responsible with those who mislead them. We have laws which prohibit and make it an offense to keep Engine Men and Train Men on the road over sixteen hours—a law which insists that these men must be exempt from duty a certain number of hours before again being call-

ed, but we have not any law that compels Enginemen and Trainmen to rest while off duty. We have no law in this respect other than the law of nature and a moral obligation to be physically and mentally fit when called to go out on the road.

Under these conditions, any man who deliberately or otherwise spends the hours which should be devoted to rest in dissipation of any kind, or who fails to obtain needed rest is a criminal in intent, if not in purpose.

In seeking for the cause of railroad accidents, reference has been made to two factors, which, it is considered, contribute largely to accidents and a consequent loss of life.

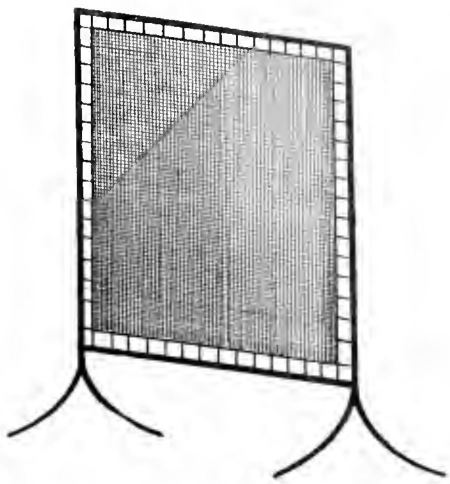
The first is, that familiarity with dangerous conditions make men careless. To a limited extent, this may be true, but the fact must not be overlooked that the element of personal safety enters largely into the make up of the average man and that this element applied to men in railroad service, particularly operation, for obvious reasons constitutes a safeguard to others to an extent that it does not in any other occupation.

The second factor which it is stated is also largely responsible for accidents, is lack of concentration upon the work in hand—men who work in offices—Bookkeepers, Accountants, Draftsmen, etc., will admit this theory is correct and that it is not possible to do good work unless one's thoughts are centered on one's work.

If Enginemen, Trainmen and others engaged in the operation—direct operation of railroads—have domestic troubles, financial or other worries, they do themselves and others an injustice when they attempt to perform duties calling for alertness and absolute attention to the work in hand—work which if badly performed may result in loss of life and serious damage to property.

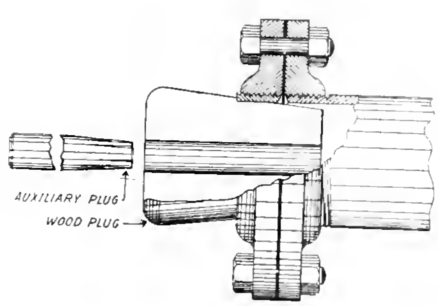
Tons of literature and good literature at that, have been scattered broadcast among railroad employees to get them interested in the safety and efficiency movement. Millions of dollars have been expended in equipping railroads with safety devices and other appliances calculated to prevent accidents, yet regardless of this expenditure of time and money, we are still a long way from the goal of our exertions.

Why have we not succeeded in securing this cooperation? There are several reasons, but the principal one is because, to a great extent, we have in our safety and efficiency campaigns overlooked an important element in the organization of our railroads, viz, the true connecting link between the rank and file and the official class, to wit, the subordinate official or in other words, the gang boss, Sub Foreman, Foreman, Traveling Engineer, Traveling Fireman, Train Master, Supervisor—the man who is invariably promoted from the ranks, who in many cases does not rise above the position of subordinate official, the man whose sympathies are with the rank and file of which he is and practically always remains a member, the man who can and does exert a tremendous influence over the men for good or bad, according to his, the subordinate official's training and views on different questions of the day.



SAFETY SCREEN.

We train and fit the boys to make good workmen—workmen to make good division officials, then draw on colleges for executive ability and higher education, but little if anything has been done in the way of moulding the "bumper post", the subordinate official, to our interests, or in broadening his views on important matters and little if any care is taken in selecting men for such positions beyond the fact that they must be good mechanics, good Engineers or good



PIPE PLUG.

Trainmen, as the case may require. Yet, as stated before, the "bumper post" exerts more influence for good or evil than we realize; an oversight easily remedied.

After thirty years railroad service under five different flags, my experience has demonstrated to my satisfaction, at least, that we cannot attain to economical efficiency in railroad service without the hearty cooperation of the subordinate official and the rank and file, and to abtain the latter we must first obtain the former, and to do this, we must see that subordinate officials in addition to being competent in their particular line of work, are broadminded men with sufficient intelligence back of them to command the respect and cooperation of the rank and file.

Men who cannot check themselves and they are legion—cannot control those under them, and men who cannot control those under them cannot command the respect and cooperation necessary to accomplish good results in any direction and are consequently a detriment to the company and a drawback in all matters pertaining to progress, including safety and efficiency.

It has been said that the secret of Abraham Lincoln's success was due to the fact that he understood the value of self judgment and was never afraid to look at himself. Lincoln would analyze his motives, weaknesses, possibilities and limitations and then pass judgment upon himself as calmly as upon any other man.

We cannot all have the grace and goodness of Lincoln, but surely we nearly all have the faculty of learning a lesson, and to my mind the chief lesson that should be learned in railroad work, is to examine one's self, to look inward not outward, to devote every minute at work to a careful mastery of the matter in hand, to live soberly and decently in our leisure hours, to improve the mind by reading and study, and when we know ourselves and can do our work as it should be done, we are reaching towards the highest degree of efficiency.

WILLIAM GOODYEAR.

Laredo, Tex.

Safety Screen and Pipe Plug.

By J. G. KOPPEL,
Sault Ste. Marie, Ontario.

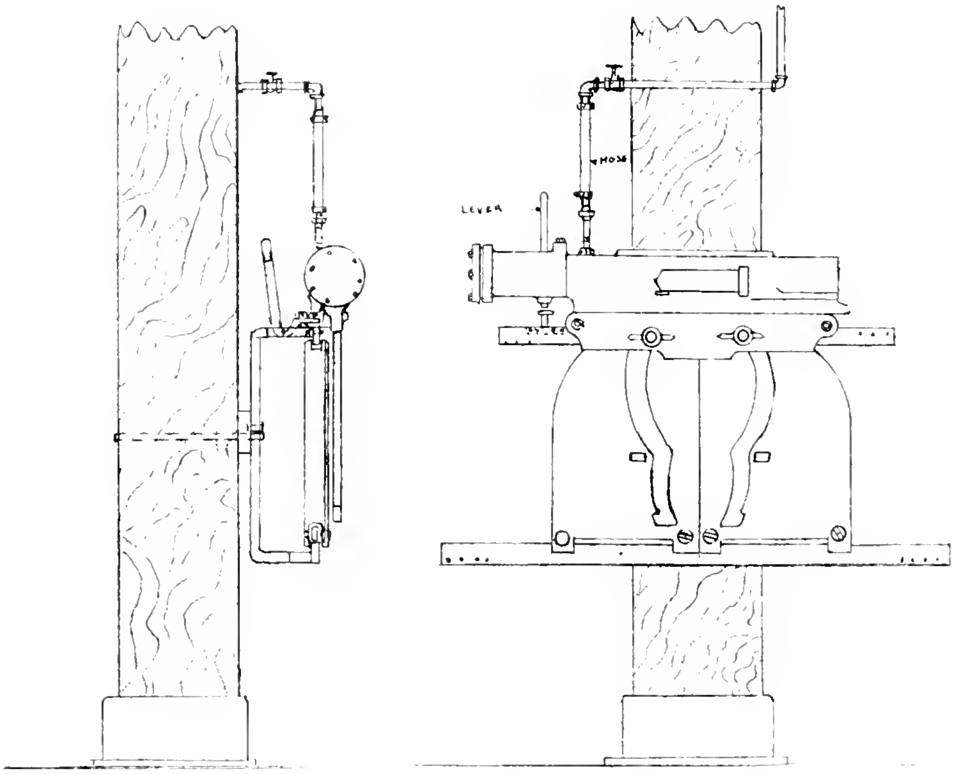
The first of the accompanying drawings shows a device, which, perhaps, some railway shop men would not believe to be a part of railway repair shop equipment.

The frame is made of ⅝ in. round iron 2½ ft. by 2 ft., and the enclosed space is fitted with a screen of any color or kind of strong bag cloth. The outfit is very handy where cold rivets or nuts are being cut off with a chisel and sledge hammer. The rivets and nuts almost always fly off with considerable velocity, and not infrequently employees have been injured, and more often moving machinery or other equipment have been damaged by the flying missiles.

The appliance may be readily stationed in what may be termed the line of trajectory, near the base of operations, and when the separated metal takes wing it flies into the screen and falls harmlessly to the ground.

The second device may be useful to roundhouse foremen when it is found necessary to stop running water from a

broken water main, and it appears to be very inconvenient to stop the supply of water from the entire establishment.



TEST RACK FOR PNEUMATIC FIRE-DOOR OPENERS.

A wooden plug may be ready or easily made with a hole drilled in the center. This plug, may be driven into the broken water pipe without much trouble, because the water pressure finds a partial relief through the auxiliary hole. Then the auxiliary hole may be easily closed with an ordinary plug as shown.

Test Rack for Pneumatic Fire-Door Openers.

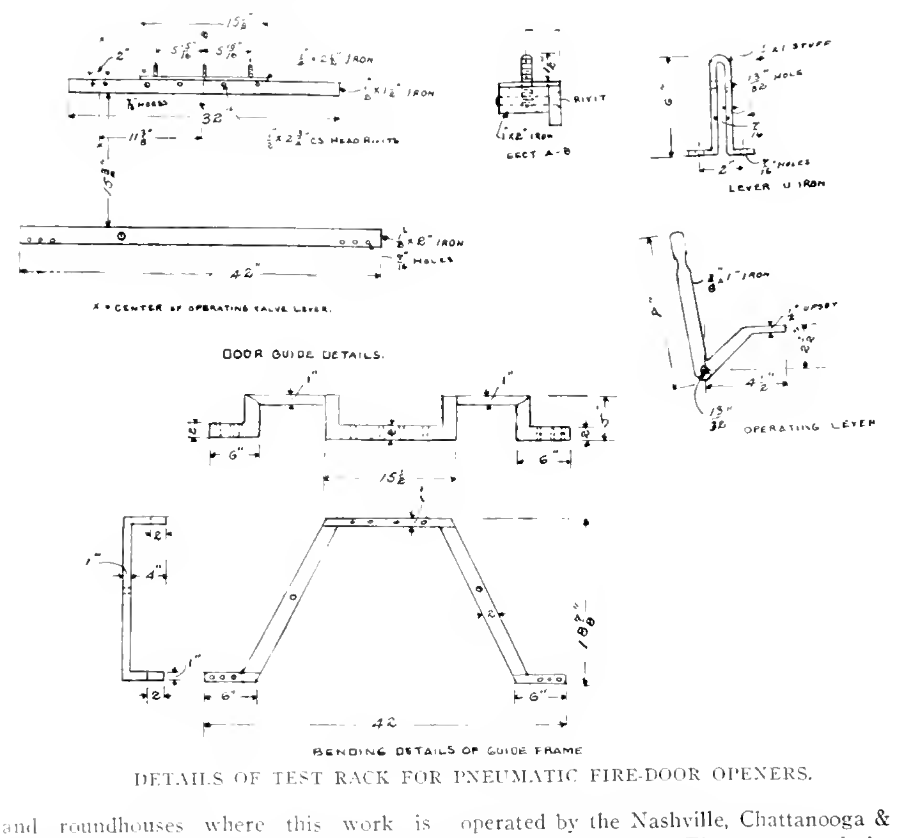
By F. W. Bentley, Jr.

Milwaukee, Wis.

Pneumatic fire-door openers are perhaps at times one of the most troublesome parts contributing to the difficulties encountered by the roundhouse force in general. Lack of care and proper adjustment is in the main, of course, responsible for most of their defects, which invariably make an appearance at a time when repairs or changing of parts will be the cause of a house or other failure to the locomotive.

The accompanying sketches are descriptive of a simple test rack for use in small shops adjacent to large roundhouse facilities which will, from the experience of the writer, eliminate all fire-door difficulties. The defective openers can be repaired carefully in the shop, tested out and adjusted under exactly the same conditions imposed on them by service on the locomotive. The opener, when then applied to the locomotive, is ready for operation at once. The doors on the rack are also parts which are fitted, and need only be slipped from the rack and applied to the locomotive in case of a breakage of this part of the equipment.

The device is easily and cheaply made. For smaller outside combination shop and roundhouses where this work is done, but at which no heavy stock of parts is carried under repair by the stores department, the test rack will be found a valuable aid in affording first class repair work on the opener apparatus as well as being a prevention against house failure when the parts can be quickly slipped from the rack and applied to the locomotive in perfect condition.



DETAILS OF TEST RACK FOR PNEUMATIC FIRE-DOOR OPENERS.

A War Veteran.

By R. S. Booth.

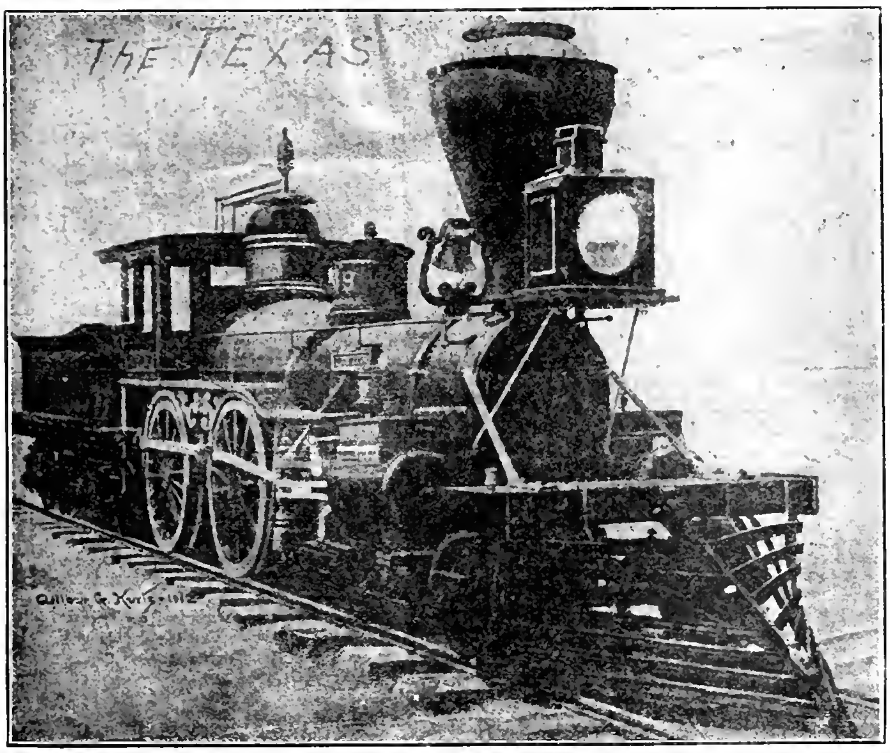
It was very gratifying to see in a recent issue of Railway and Locomotive Engineering a fine illustration and descriptive matter in relation to a famous war locomotive named the "General," and I have endeavored to secure a photograph of another war engine equally famous, if not more so, named the "Texas." We do not fully realize what an important part the crude railways and equipment played in the great civil conflict until one talks with some veteran railroad man who had been through some of it.

It is said that a French statesman on being asked what he had to say about the French revolution remarked briefly that he had come through it. The same may be said of quite a few locomotives in regard to the civil war. Regarding the "Texas" it will be remembered by many of your readers that on April, 1862, a number of Union soldiers laid a plan to capture a locomotive that ran from a point north of Atlanta, Georgia, to Chattanooga, Tennessee, over what is still known as the Western & Atlantic Railroad, and now operated by the Nashville, Chattanooga & St. Louis Railway. The capture of the locomotive "General" was effected near Atlanta by the Northern men, there being

over twenty men in the capturing squad, and a start was made along the line towards Chattanooga, the idea being to destroy the track and burn the bridges as they passed along and thus cut-off communication between the two points. The crew from the captured locomotive, however, followed after the raiders, first on foot and then on a hand-car until they reached a spur where another locomotive named the "Yonah" was standing with steam up. This engine did great service until another train was met that was hauled by a locomotive named the "William F. Smith," after some Southern railway magnate. This locomotive was pressed into the service and had to be discarded on account of the track being torn up near Kingston, and the determined men ran ahead and soon met another train running southbound to which the locomotive "Texas" was attached. The engine and cars were backed to the nearest siding and leaving the cars continued the chase northward. From all accounts the speed of the "Texas" would compare favorably with the best fliers of our own day, and though compelled to stop several times to repair the track they gained on the "General" and finally recaptured the locomotive and made prisoners of nearly all of the Northern soldiers. The "General" had been compelled to stop, having run out of both fuel and water. The "General," as stated in your columns, is now finely painted and polished and housed in Chattanooga.

The "Texas" has been modernized to some extent, but there is a movement on foot to repair the old locomotive and make the general appearance as nearly as possible the same as in the war days. It would be very fitting to have the rare relic housed at Atlanta where the raid commenced, and where it could not fail to be looked upon as an interesting memento of the stormy days of broil and battle. The locomotive as shown in the photograph is an old American type of locomotive or 4-4-0. Some of its peculiar features are as follows:

The tumbling shaft is supported by cast-iron brackets bolted underneath the frame instead of on top, and has an arm with adjustable counterweight to equalize the weight of the links and eccentric rods instead of a spring. The links are almost above the truck and necessitate the use of very long eccentric rods. There are no belly braces to support the boiler, but, instead, there are two boiler braces on each side fastened to boiler and frames rigidly together, about halfway between the cylinders and firebox. There is no metallic packing on valve stems or pistons and the valve rod connecting to rocker arm has a strap and key instead of a pin and bushing that are familiar in our time. There are no brakes on the engine, but the tender is equipped with hand brakes and has a large brake wheel within easy reach of the fireman. The horizontally-barred pilot gives a peculiarly rakish look to the engine. The headlight is very large for so small a locomotive. Bullet marks are on the headlight as if the Northern riflemen had been trying to make bull's eyes during the wild chase that ended, as is well known, so disastrously for themselves.



LOCOMOTIVE "TEXAS," WESTERN & ATLANTIC RAILROAD.

McBain's Object Lesson.

There is a constant pressure put upon firemen to save coal and avoid smoke, but there is too little direct instruction. When D. R. McBain was traveling engineer of the Michigan Central, pressure was put upon him to effect some coal saving and he started out by talking with the engineers and firemen, telling them what might be done. Then he began riding on the engines and observing things. At one of the Traveling Engineers' Conventions, among other notes of experience, he said:

When I saw an engine coming into Jackson with black smoke rolling or pops blowing, I never failed to go and ask why it was necessary for the engine to come in in that condition. I asked firemen, "Is it necessary that you put in a fire after you pass Trumbull?" "Yes," was the answer, "we must put in a fire at Trumbull. It is four miles to Jackson." "How much?" "At least six or eight shovelfuls." "That doesn't seem necessary." The outcome was that I put in a week teaching them. When we reached Trumbull I said to the fireman, "That will do." Then we used steam for three miles and when steam was shut off approaching Jackson, the fire was pretty well burned down, 140 pounds of steam by gauge and lots of water in boiler. Instead of applying six or eight shovelfuls at Trumbull the firemen have learned that it is to their advantage to stop firing there. They save throwing that weight of coal and the company gets the benefit and the engine does not come in puffing steam or rolling out black smoke.

In a great many instances we found that the younger men were beating the older men on fuel consumption. We took two records of engineers and said: "So and so has been running opposite to you this month and he has beat you two and a half miles to the ton of coal. How do you account for that?" The usual excuses would be given but on the following month both men would make about the same mileage to the ton of coal.

Teak Wood.

So indestructible is African teak wood, that sea going vessels built of it are known to have lasted more than 100 years. This wood is one of the most remarkable materials employed in industries, when it can be procured. Teak is remarkable for its great weight, hardness and durability, its weight varying from 42 to 52 pounds per cubic foot. Pine wood weighs about 30 pounds to the cubic foot. Teak works easily, but from the large quantity of solid contained, the tools require to be hard, and even then, they are subject to rapid wear. It contains an oil which prevents nails driven into it from rusting and its durability is very great.

Mikado and Mountain Type Locomotives for the Rock Island

It is generally acknowledged that recent developments in railroad transportation have demonstrated that the most efficient way to handle heavy traffic is with powerful locomotives and large train loads. Powerful operating units, having proved their ability to reduce operating costs in freight service, have attracted the attention of motive power officials to their heavy passenger service.

Large reductions in operating costs have been made by the Rock Island Lines by the adoption of heavy Mikado locomotives. The policy was the direct cause of putting into passenger service thirty large and powerful Pacific type locomotives and two of the heaviest mountain type locomotives ever built, which have recently been delivered to the Rock Island Lines by the American Locomotive Company.

The Pacific type engines are operating at present between Rock Island, Ill., and Tucumcari, N. M. The maximum grade per mile from Rock Island, Ill., to Phillipsburg, Kans., is about 60 feet per mile, and from Phillipsburg, Kans., to Limon, Colo., is a constant up-hill pull 247 miles long, the ruling grades being 53 feet to the mile.

Repeated test trains were run to determine the capacity of these Pacific type locomotives. The results, as compared with the carded time of several regular trains, were all largely in favor of the new locomotives. The regular train, known as No. 5, taking 5 hours and 16 minutes on the westward, up-grade trip, was made during several tests in 4 hours and 47 minutes. The average schedule speed of the regular trains being 31.4 miles per hour, being made with the new locomotives at a speed of 32.1 miles per hour. The number of cars were also increased from 11 to 12, the average weight of cars being also increased from 62 to 75 tons. The train tonnage, exclusive of lading being in the older class 682 tons and in the new class 900 tons.

Taking another illustration of time and tonnage between Valley Junction, Ia., and Council Bluffs, Ia., a distance of 136.0 miles, the actual running carded time of train No. 5 was 3 hours and 47 minutes, and that of the test made by the new equipment 3 hours and 24 minutes, each making 3 stops, the older trains with 11 cars and the new test train 12 cars, of 62 and 75 tons, respectively, the tonnage as before being 682 tons and 900 tons.

In the Colorado Division the results were even better, showing an average gain in time of over 10 per cent. and in tonnage of over 20 per cent. But the most remarkable showing as evidenced by the reports is being made in the Missouri division from Davenport to Eldon, where the average running time for a distance of 111.6 miles was made by both trains in 2 hours and 40 minutes, the carded time trains having 6 cars, or 390 tons, exclusive of lading, and the test, known as No. 16, with 933 tons.

No difficulty was experienced in maintaining full boiler pressure at all times. The locomotives steamed very freely and very little black smoke was emitted at the stack. The maximum cut-off was 16 inches, and the locomotives were worked there only for short distances, nearing the apex of severe hills. Except for hard pulls, the locomotives were generally worked at 6 to 8 inch cut-off. The handling of air was satisfactory, no discomfort being experienced by passengers in rear cars of these long trains from this cause.

While no extensive tests have been conducted to determine economy on fuel and water of the new Pacifics, it was the opinion of the engine crews on these heavy trains that there was no increase over the older Pacific types.

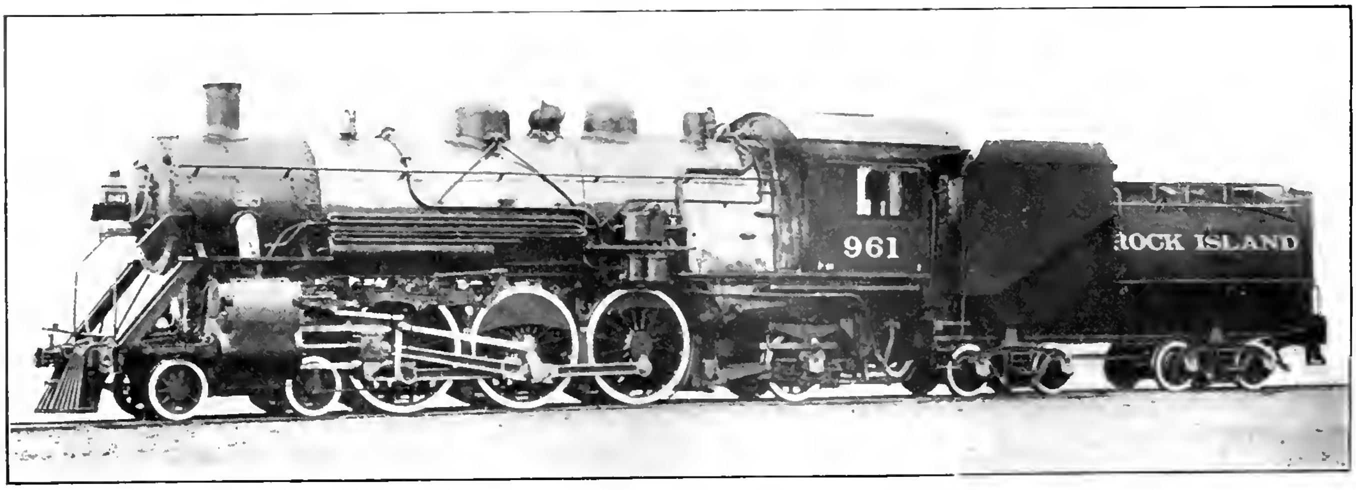
Were it not for their introduction on this line at this time, it would have been necessary to either double-head or operate in two sections.

By the introduction of the Mountain type locomotives, the Rock Island has been enabled to consolidate the Chicago and St. Louis sections of one of the Colorado trains between Phillipsburg and Limon. This has effected a saving of 180,310 passenger train miles per annum.

At present these combined trains consist of 10 to 13 cars, which can be satisfactorily handled by the new Pacifics, except in extreme weather. Therefore, there has been no opportunity as yet to test the Mountain type to its full capacity. However, it is anticipated that they will handle 1,000 tons in 16 cars on the carded time of these combined trains without difficulty. Their consist, under normal conditions, will be 15 and 16 cars, largely steel equipment, which the Mountain type locomotives will ably handle over the 247 miles 1 per cent. grade constant up-hill pull westbound from Phillipsburg to Limon. Westbound this combined train has nine scheduled stops and 20 flag stops between these two points, which make the Mountain type more efficient than the new Pacific type on account of their greater starting effort.

In general construction the designs embody the latest approved practice and follow the standards of the builders. Each design is equipped with a superheater, brick arch, screw reverse gear, extended piston rods, long main driving boxes, Woodard engine truck, speed recorder, Baker valve gear, Chambers throttle, the Mudge Slater smokebox arrangement and vanadium cast steel frames. The Mountain type is also equipped with the Foulder main rod, and engine and tender were arranged so that the Street Stoker could be applied later if desired.

These designs are the product of the long experience of the American Loco-



PACIFIC TYPE LOCOMOTIVE FOR THE CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.
W. J. Tollerton, Gen. Mech. Supt. American Locomotive Company, Builders.

motive Company in the development of powerful locomotives. The application of this experience to the railroad's specific requirements was directed by the officials of the motive power department, to whose valuable co-operation in the preparation of the designs the success of the locomotives is largely due. They furnish another striking example of reduced operating costs which have been obtained by combining fuel saving devices and improved designing in a larger and more powerful operating unit.

The following are the general dimensions of these locomotives:

PACIFIC TYPE LOCOMOTIVES.

Track gauge, 4 ft. 8½ ins. Fuel, bituminous coal.

Cylinder—Type, simple piston; diameter, 25½; stroke, 28.

Tractive power—Simple, 40,260 lbs.

Factor of adhesion—Simple, 4.34.

Wheel base driving—13 ft. 0 ins.; rigid, 13 ft. 0 ins.; total, 33 ft. 10 ins.; total, engine and tender, 65 ft. 1¼ ins.

Weight—In working order, 281,500 lbs.; on drivers, 174,500 lbs.; on trailers, 54,000 lbs.; on engine truck, 53,000 lbs.; engine and tender, 440,300 lbs.

Boiler—Type, extended wagon top; O. D. first ring, 76⅜ ins.; working pressure, 190 lbs.

Firebox—Type, wide; length, 108 ins.; width, 84 ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 6 ins.; sides, 5 ins.; back, 5 ins.; depth (top of grate to center of lowest tube), 22 ins.

Crown staying—Radial.

Tubes—Material, seamless steel; number, 195; diam., 2¼ ins.

Flues—Material, seamless steel; number, 34 ins.; diam., 5½ ins.

Thickness—Tubes, .135 M. M. G.; flues, 150 ins. M.M.G.

Tube—Length, 26 ft. 0 ins.; spacing ⅞ ins.

Heating surface—Tubes and flues, 3,259.4 sq. ft.; firebox, 212.8 sq. ft.; arch tubes, 25.4 sq. ft.; total, 3,497.6 sq. ft.

Superheating surface 805 sq. ft.

Grate area—63 sq. ft.

Wheels—Driv. dia. outside tire, 73 ins.; center diam., 66 ins.; driv. material, main, cast steel; others, cast steel; engine truck, diam., 34 ins.; kind, cast iron; trailing truck, diam., 45 ins.; kind, cast steel; tender truck, diam., 34 ins.; kind, cast iron.

Axles—Driving journals, main, 11 x 22 ins.; other, 10½ x 13 ins.; engine truck journals, 6½ x 12 ins.; trailing truck journals, 9 x 14 ins.; tender truck journals, 6 x 11 ins.

Boxes—Driving, main and others, cast steel.

Brake—Driver, Amer. W. N. 2, West. E. T. 6; trailers, West. E. T. 6; tender, West. E. T. 6; air signal, West. L.; pump, West. 8½ C.C.; reservoir, 2 18½ x 102.

Engine truck—Four wheel, Woodard design.

Trailing truck—Radial.

Exhaust pipe—Single; nozzles, 5⅞, 6, 6¼.

Piston—Rod diam., 4½ ins.; piston packing, gun iron rings.

Smokestack—Diam., 18 ins.; top above rail, 15 ft. 7¾ ins.

Tender frame—Vanderbilt type.

Tank—Style, Vanderbilt cylindrical; capacity, 8,500 gallons; capacity fuel, 14 tons.

Valves—Type, piston 14 ins.; travel, 6½ ins.; steam lap, 1 1-16; cl. ⅛ in.

Valve setting, 3-16 in. lead.

MOUNTAIN TYPE LOCOMOTIVES.

Track gauge, 4 ft. 8½ ins. Fuel, bituminous coal.

Cylinder—Type, simple piston; diam., 28 ins.; stroke, 28 ins.

Tractive power—Simple 50,000 lbs.

Factor of adhesion—4.50.

Wheel base—Driving, 18 ft. 0 ins.; rigid, 18 ft. 0 ins.; total, 38 ft. 11 ins.; total, engine and tender, 70 ft. 2¼ ins.

Weight—In working order, 333,000; on drivers, 224,000; on trailers, 51,500; on engine truck, 57,500; engine and tender, 490,500.

Boiler Type, Wagon top, O. D. first ring, 78 ins.; working pressure, 185 lbs.

Firebox—Type, wide; length, 108 ins.; width, 84 ins.; thickness of crown ⅜; tube, ⅝; sides, ⅜; back, ⅜; water space, front, 6 ins.; sides, 5 ins.; back, 5 ins.; depth (top of grate to center of lowest tube), 29½ ins.

Crown staying—Radial.

Tubes—Material, steamless steel; number, 207; diam., 2¼ ins.

Flues—Material, seamless steel; number, 36; diam., 5½ ins.

Thickness—Tubes, 135 M. M.; flues, 150 M. M.

Tube—Length, 22 ft. 0 in.; spacing, ⅞ ins.

Heating surface—Tubes and flues, 3,805 sq. ft.; firebox, 287 sq. ft.; arch tubes, 25 sq. ft.; total, 4,117 sq. ft.

Superheating surface, 944 sq. ft.

Grate area, 62.7 sq. ft.

Wheels—Driv. diam. outside tire, 69 ins.; center diam., 62 ins.; driving material, main, cast steel; others, cast steel; engine truck, diam., 33 ins.; kind, rolled steel; trailing truck, diam. 42 ins.; kind, cast steel; tender truck, diam., 33 ins.; kind, rolled steel.

Axles—Driv. journals, main, 11½ x 22 ins.; other, 11 x 13 ins.; engine truck journals, 7 x 12 ins.; trailing truck journals, 9 x 14 ins.; tender truck journals, 6 x 11 ins.

Brake—Driver, Amer. W. U. 3, West. E. T. 6; trailers, West. E. T. 6; tender, West. E. T. 6; air signal, West. L.; pump, 8½ C. C.; reservoir, two 18½ x 102 ins.

Engine truck—Four wheel Woodard design.

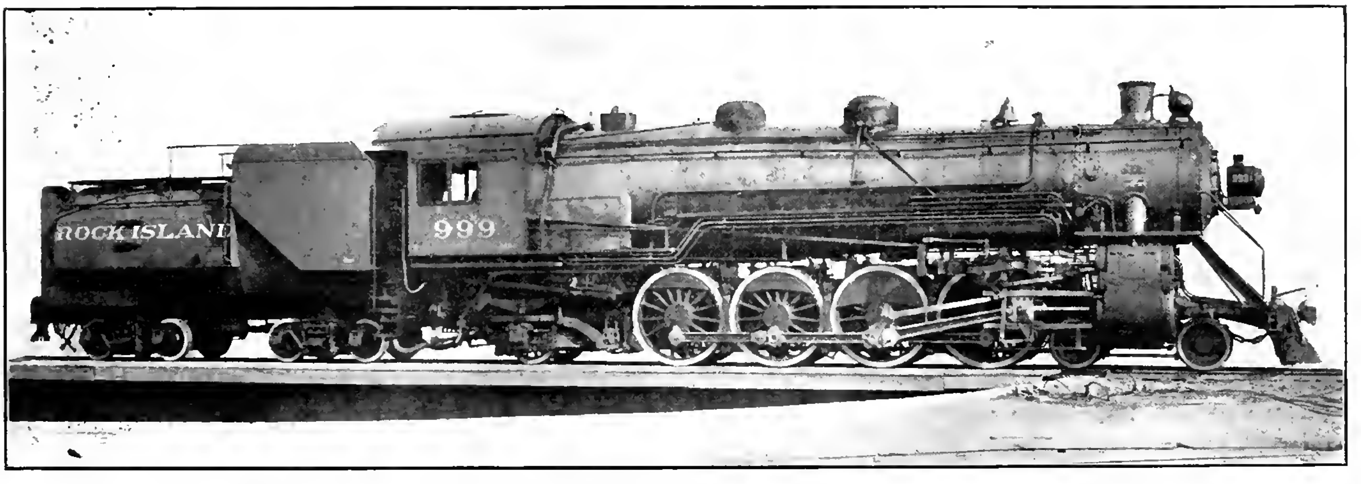
Trailing truck—Radial.

Exhaust pipe—Single; nozzles, 6 3-16, 6 5-16, 6 7-16 ins.

Piston—Rod diam., 4½ ins.; piston packing, gun iron rings.

Tank—Style, Vanderbilt cylindrical; capacity, 8,500 gallons; capacity fuel, 14 tons.

Valves—Type, piston, 16 ins.; travel 6½ ins.; steam lap, 1 1-16 ins.; Cl., 1-16 in.



MOUNTAIN TYPE LOCOMOTIVE FOR THE CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

Catechism of Railroad Operation

NEW SERIES.

Second Year's Examination.

(*Continued from page* 50, *February*, 1914.)

Q. 1.—Name the different types of boilers on this road?

A.—The wide firebox boiler and the narrow firebox boiler.

Q. 2.—What is a wide firebox boiler? What is a narrow firebox boiler?

A.—A wide firebox boiler is one that has the firebox extending out beyond the frames on each side. A narrow firebox boiler is one on which the firebox extends down between the frames.

Q. 3.—How is the firebox stayed to the outside sheets of boiler?

A.—By stay-bolts, which are screwed in through both sheets from the outside (being taper fitted) and riveted on both ends.

Q. 4.—How do you tell when a hollow stay-bolt is broken? Also what are indications of broken stay-bolts that are not drilled?

A.—Water will spurt out of the end where hole is drilled. When solid stay-bolts are broken they may be located by the sheets being a little bulged or crooked, but the shop force use the hammer test to find them.

Q. 5.—What will cause blistering of fire-box sheets and bulging between stay-bolts?

A.—Mud or scale accumulated on the sheets will cause them to blister and bulge, or an accumulation of oil on sheet will cause this, because it keeps the water away from sheet.

Q. 6.—What is scale in boiler caused by?

A.—A mineral substance (generally limestone or clay) in the water is deposited on sheets and baked there by the heat, forming the scale on the sheets and tubes.

Q. 7.—What is the effect of scale in a boiler?

A.—It hinders the radiation of heat into the water from the fire and causes the sheets to become defective through the unequal expansion and contraction and causes sheets to become crystallized and burned.

Q. 8.—What difference does the scale make on the temperature of the flues and fire-box sheets?

A.—On account of the deposit keeping the water from the metal there is an overheating and very unequal expansion and the parts directly exposed to currents of heat and cold contract more quickly after being expanded and joints are opened and caused to leak.

Q. 9.—How can you detect the presence of scale or mud on the sheets of a fire-box?

A.—By the sheets bulging or forming pockets between the stay-bolts where the deposit of mud or scale is present.

Q. 10.—Explain the principle upon which the steam gauge operates?

A.—The steam gauge has a tube which is circular in form, to one end of which is a rack which operates on a pinion connected to the pointer or hand on the gauge, the tube being connected at the other end with the boiler steam pressure, feels the influence of this pressure and tends to straighten out, in that manner moving the rack on pinion and causing hand to move along dial indicating the pressure, a tension spring works against the action of tube and moves hand back as pressures decrease.

Q. 11.—How are the tubes fastened in the sheets at front end and back end.

A.—At the front end a ferrule of Canada plate (iron) is generally used, although some roads use copper for the ferrule, which is placed between the tube and sheet, the tube is then expanded and rolled tight. At the back end in the fire-box a copper ferrule is placed between the tube and sheet, the tube is then expanded, rolled out to form a bead and caulked up to the sheet.

Q. 12.—Describe the different methods of supporting the crown sheet of the fire-box by crown stays and radial stays?

A.—Where crown stays are used bars which rest on the upper edge of the back and front sheets, called crown bars, extend over crown sheet and the crown bolts are supported by these bars. Some boilers of more modern type have a hinged stay supported by outer shell of boiler and passing through the crown sheet and threaded like a stay bolt in both sheets and riveted at each end the hinge accommodates the varying positions of sheets caused by expansion and contraction. The radial stay is like a stay bolt and reaches through crown sheet from outer shell of boiler and is adapted to the curvature of the sheets through which it passes. It is threaded in both sheets and riveted at each end.

Q. 13.—To what strains is a fire-box subjected in addition to those caused by the steam pressure?

A.—Expansion and contraction, besides the weight of the water.

Q. 14.—What are the two main causes of unequal expansion and contraction in fire-box and flues?

A.—Improper firing and pumping at time when fire is not bright.

Q. 15.—Why is the admission of an excessive amount of cold air through the grates and fire door injurious?

A.—Because it cools off the flues and fire-box sheets suddenly and will cause them to become weakened and leak.

Q. 16.—What is meant by circulation of water in the locomotive boiler?

A.—It is the movement of the water in the boiler, on account of the cooler water going down toward the bottom of the boiler, and the heated water is moving toward the top or going away from the heated sheets and the cold water going toward them.

Q. 17.—Is the water pumped into the boiler by the injector hotter or colder than that in the boiler?

A.—It is much colder.

Q. 18.—Where does this water flow to after entering the boiler?

A.—It goes down toward belly of boiler and flows back to the fire-box, then as it reaches the hot sheets it begins to rise to the top of water level and circulates ahead and follows sides of boiler down and as it is heated by contact with the flues it rises up through them and in that way is in constant circulation until turned into steam.

Q. 19.—Is there any difference in the temperature of the water between the top and bottom of the water in the boiler?

A.—Yes. There is nearly 200 degrees less temperature in the water at the bottom than at the top, depending on steam pressure.

Q. 20.—How should the injector be used in order to prevent, as far as possible, damage to the boiler?

A.—The injector should never be used when the fire is not burning brightly especially near the flue and side sheets, and an effort should be made to work the injector in such a manner that there will be no sudden reduction in temperature at any time.

Q. 21.—How much water should you have in the boiler when it is delivered at the ash pit or round house track?

A.—The boiler should have enough water in it at all times to protect the crown sheet, and when left at round house track should have a full supply of water in it to protect it until the round house force take charge of it.

Q. 22.—When should this water be put in?

A.—The boiler should be filled up while the fire is burning brightly at end of trip.

Q. 23.—Explain the use of the blow-off cock?

A.—The blow-off cock is to be used in clearing the water of foreign matter that causes it to foam, and should be used when standing still after filling boiler with water and the fire is burning brightly, blowing out about two or three gauges of water, depending on height of water above crown sheet. The injectors may be kept at work while the blow-off cock is open, if the fire is in condition to prevent cooling effect.

Q. 24.—How should the draught be distributed in the fire-box?

A.—Evenly all over the entire grate surface.

Q. 25.—Name the various adjustable appliances in the front end by which the burning of the fire is regulated?

A.—Nozzle tips, petticoat or draft pipe, and diaphragm plates.

Q. 26.—What does it indicate when the exhaust issues strongest from one side of the stack?

A.—It indicates that the draft pipe is out of plumb, caused by loosening of supports, or it may be that the nozzles are out of plumb, so that the exhaust does not strike the center of the smokestack.

Q. 27.—Why is it important that there be no holes through the smoke-box sheets or the front end and none in smoke-box seams or joints?

A.—It would spoil the vacuum formed by the forced draught and injure the steaming qualities of the engine.

Q. 28.—Describe the principles upon which the inspector works?

A.—A jet of high velocity steam passing through a small orifice strikes the water and is combined with the water, and condensed into water giving to the water part of its velocity, carrying the water along through smaller openings, and in that manner increasing its velocity, to such an extent that it has a force sufficient to overcome the boiler check and pass into the boiler.

Q. 29.—What is the difference between a lifting and a non-lifting injector?

A.—A lifting injector must have parts that will raise the water up into the body of the injector which is placed above the water level, and such other parts as will force the water into the boiler, while the non-lifting injector being placed below the water level has only such parts as will force the water into the boiler, the water flowing into it through force of gravity.

Q. 30.—Will injector work with a leak between injector and tank? Why? Will it prime?

A.—No. Because the air will spoil the vacuum. No. It will not prime for the same reason.

Q. 31.—If it primes good but breaks when the steam is turned on, where would you look for the trouble?

A.—Would look for some obstruction in the delivery tubes, or in discharge pipe, or boiler check might be stuck shut, or feed pipe might be stopped up or leaking.

Q. 32.—If it will not prime, where would you inspect to find the trouble?

A.—In the supply pipe, either the feed water too hot, a leak, or an obstruction in the feed pipe or strainer.

Q. 33.—Will injector prime if checks leak badly or are stuck up? If injector throttle leaks badly?

A.—No. Because the hot water and steam getting into the feed pipe spoils the vacuum formation.

Q. 34.—If steam or water shows at the overflow pipe when injector is not working, how do you tell whether it is boiler check or throttle leaking?

A.—With the boiler check leaking considerable water will show at the overflow pipe, and with throttle leaking steam will show at overflow pipe. To be sure you may test by closing the main steam valve at the fountain head and in that manner shut off the steam from the injector, or by forcing the boiler check to its seat with the combination boiler check and stop the flow of water from boiler. Another way is to open the pet cock in discharge pipe and if water comes from it with force it indicates that the check is stuck open.

Q. 35.—Will injector prime if primer valves leak? Will it prevent its working?

A.—Yes, it will prime. It will not prevent it working if primer valve leaks.

Q. 36.—Will an injector work if air cannot get into tank as fast as water is taken out?

A.—No. It will not work.

Q. 37.—Will an injector work if all of the steam is not condensed by the water?

A.—It will not work as it should, and if it works at all it will waste a great amount of water at the overflow. Generally it will not work at all.

Q. 38.—What precaution should be taken to prevent injectors from freezing when not being used?

A.—It should be changed into a heater to keep the feed pipe and discharge pipe from freezing.

Q. 39.—How would you set a heater on the various types of injectors in use on this road?

A.—On the twin Hancock injectors it is necessary to close the overflow valve and open the throttle valve enough to furnish sufficient steam to circulate in the delivery and feed pipes, and the drain cock in delivery pipe must be opened a little, and tank valve nearly closed. On other types of injectors after closing the overflow valves, close the main steam valve and open the injector throttle valve wide, then regulate the steam by opening the main steam valve the necessary amount to provide the circulation.

Q. 40.—Is any more water used when a boiler foams than when the water is solid?

A.—Yes. Because water is being carried out through cylinders with the steam.

Q. 41.—How should lubricator be filled?

A.—All feeds should be closed, water valve closed, condensation drained from the oil chamber, and then the oil chamber should be filled to within about one-half an inch of the top. (It should never be filled to overflowing because the oil expands with the heat and space should be allowed for the expansion.) The water valve should be opened as soon as the plug is put in the filling opening, to allow the condensation to raise the oil to top of oil well.

Wise Don'ts.

When a new device is added to a locomotive many men begin at once to expect performances from it that the inventor never thought of. The superheater has proved very efficient, but we greatly admire the list of "don'ts" covering its performance suggested by a committee of the Foundry Engineers' Association, of which Mr. J. W. Hardy was chairman. The list reads:

"Don't expect too much of the superheater; it is not intended to overcome blows or stop steam leaks or square valves, and it is like some children—won't keep itself clean.

"Don't forget when switching that there is more steam between the throttle and cylinders with the superheater than with the saturated steam engine—the superheater holds some.

"Don't carry water too high just because you don't hear any in the smoke stack. You might be using your superheater to boil water instead of heating steam.

"Don't think because your engine steams that you are getting the full value of the superheat; your engine may not be calling for the capacity of your boiler.

"Don't close your throttle entirely on road engines until you get to going quite slow; your cylinder lubrication will be much better.

"Don't fire your coal too wet; it won't clinker so badly if reasonably dry. The more you rake the fire the more the flues will stop up. There are only two reasons why a fire should be raked; one, because too much coal is used, and the other because it is not put in the right place.

"While there is a great difference in coal, there is not as much difference as in what YOU are able to get out of it. They tell us of the high number of heat units or B. T. U.'s in certain coal; what does that amount to, to us, if we are not able to catch them, harness them up and use them to our advantage?"

These don'ts apply with equal force to the handling of engines that are not equipped *with superheaters.*

General Foremen's Department

Report of Proceedings of the International Railway General Foremen's Association.

The annual report of the proceedings of the ninth annual convention of the International Railway General Foreman's Association, held at the Hotel Sherman, Chicago, Ill., on July 15-18 last year, is now ready and being distributed to the members. The work extends to 171 pages with numerous illustrations, and contains a complete report of all of the papers submitted at the convention and the debates on the same. There is also a complete list of the membership, with portraits of the officers and members of the Executive Committee. The typography and illustrations are excellent. The careful preparation of the work reflects great credit on Mr. William Hall, secretary-treasurer, on whom the burden of the editorial work has fallen, and to whom all communications in regard to the publication should be referred. His address is 829 W. Broadway, Winona, Minn.

Shoes and Wedges.

By W. D. Chamberlin.

It would seem as if each particular railroad shop has its own methods of doing work, but the exchange of opinions in the pages of Railway and Locomotive Engineering is always illuminating. The time was when old methods died hard, but in twentieth century practice changes are more rapid. Of course there are some jobs on which little change can be made. The lining up of shoes and wedges is one of them, as the utmost care should be observed when laying off distances or taking measurements, as the accuracy of the finished work depends, of course, upon the care which has been taken in doing it. This is true of most machine shop work, but particularly so with shoes and wedges, the work being simply a matter of taking and laying off certain measurements. The main object in view is to place the axis of the driving wheels and axles at right angles to the frames and parallel to each other, the distance from the axis of one pair of wheels to the axis of the next pair being the same as the length of the rod which connects them. There are other points which must be taken into consideration, but this is the principal one. In the first place, the frames, cylinders, boiler, etc., are supposed to be set up and firmly bolted into place. The pedestal braces should also be bolted into place. We will suppose the engine to have six drivers, the shoes and wedges being ready to set up, having been planed and fitted to the pedestal jaws, all planer work on them being finished except the face or surface, which bears against the driving box. This is left rough until properly laid out.

On the side of the frames over each jaw lay off short lines *F F*, Fig. 1, parallel to and equally distant from the top of frames. When this is done, a point *A*, Fig. 2, on back of cylinder saddle equally distant from each frame and down a convenient distance from the boiler, must be located as follows: Lay off a point *C*, Fig. 1, on the inside of each frame near the cylinder, the distance from the finished surface *D* of the front jaw being the same on both frames, and the distance down from the top of frame also being the same on both frames. Mark this point lightly with a prick punch. Now get a piece of ¼ in. wire and bend it as shown in Fig. 7. the end bent being about 1 in. long. Cut the wire off long enough so that it will reach from the point *C* to where point *A* will come, then sharpen both ends. Place the point of straight end at *C* and with bent end scribe a line on the cylinder saddle about where *A* will come, then do the same on the other frame. Where the two lines cross will be the point *A*, midway between the frames. Before locating *A* it is best to chip off the rough casting at that point and make a smooth surface to work on. Mark the point *A* with a prick punch. Now go to the right main jaw and lay off its center line *E E*, intersecting *F F* at *B*, Fig. 1.

It is best to use the main jaws to work from, but if they are unhandy to get at, use the front jaws. Take a long "fish" tram with one movable point; place the pointed end at the point *A* on cylinder saddle and set the movable point at *B* on the frame (right main jaw), the intersection of *E E* and *F F*. Take the trams to the left side of the engine, leaving it set at this distance, place the pointed end at *A* as before, and with the movable point scribe a line on side of frame over left main jaw, intersecting *F F*, thus locating at this point of intersection a point corresponding to *B* of the right side. Through this point scribe a point at right angles to the top of frame. This line is the center line of that jaw and corresponds to *E E* of the right side.

In some cases the guide yoke or other parts interfere so that the movable point of the trams cannot be set at *B*. In such cases continue the center line *E E* across top of frame by means of a square set to *E E*, the blade extending across top of frame. On this line locate a point a certain distance from edge of frame, say midway between edges, and set the tram point to this point. Take the trams to the left side of the engine, place the point at *A* as before, and with movable point scribe a line on top of frame. Now lay off the line *N N*, shown on plan view of Fig. 1, midway between edges of frame and intersecting the line scribed with trams at *X*. Scribe the line *P P* through *X*, across the top of frame, and continue it down the outside by means of a square. This latter line then is the center line of that jaw (the left main), and corresponds to *E E* of the right side. Of the two methods just described for locating this center line, the first is the best and safest, and should be used whenever possible.

The "fish" trams mentioned may perhaps be strange to some machinists. It consists of a long rod (⅜ in. iron pipe is suitable) about 12 ft. long, one end being drawn out to a rather blunt point. One ordinary tram point is used, it being provided with usual set screw so as to set it at any position on the rod.

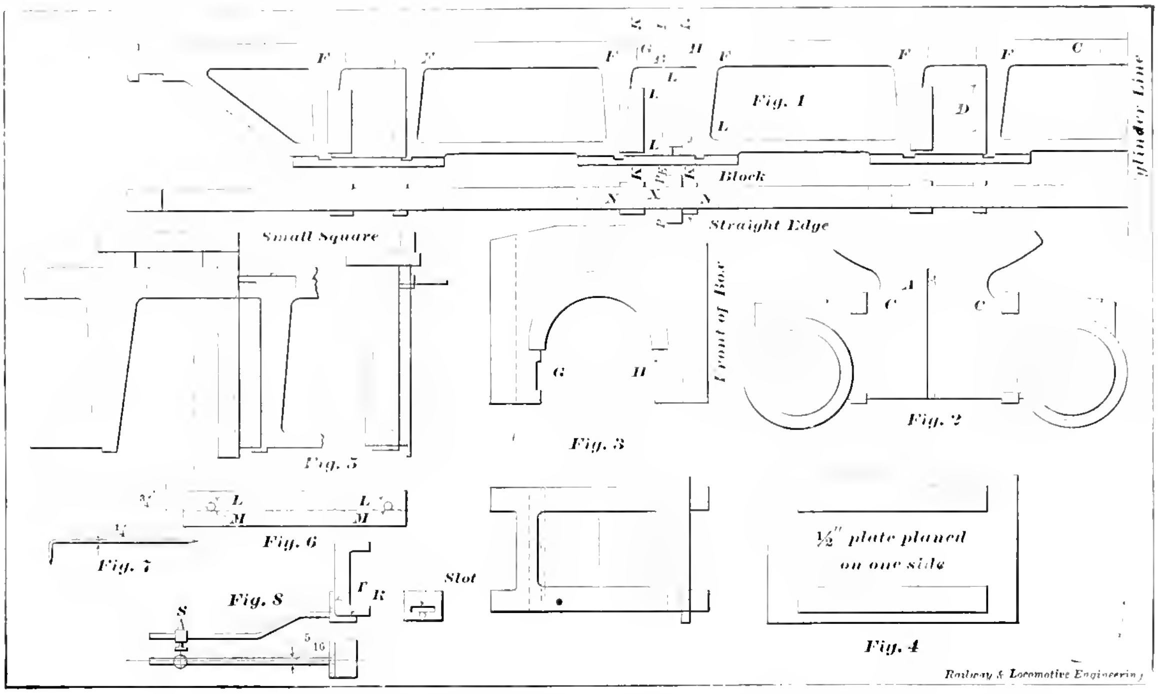
To continue with our work: We now have the center lines of the right and left main jaws. Now take an ordinary double pointed tram and carefully set it to the length of the side rods which connect the main drivers to the front drivers (it will be remembered that our engine has three pair of drivers, the middle pair being the main), place one point at *B* on the right main jaw of engine, and with the other point scribe a line on the side of frame over the right front jaw, intersecting *F F*. This point corresponds to *B* on the main jaw. Through this point scribe a line at right angles to the top of frame. This is the center line of that jaw. With the tram set at same distance, go on the other side of engine and repeat the operation for the left front jaw. Now set the tram to the length of the side rods which connect the main drivers to the third pair of drivers, and repeat the same operation for the third pair of jaws. We have now the center lines *E E* of all the jaws. The utmost care and caution should be taken in this work, as a large pair of trams can easily play tricks on the man who handles it. The work should be gone over with again in order to prove its accuracy.

This next thing to do is to consider

each driving box, which should by this time be ready to set up, the machine work on them being finished. The boxes are supposed to be bored out central; *i. e.*, $G=H$, Fig. 3. They are, however, not always bored central, owing to faults of workmanship and other causes, so it is best to take this into consideration.

Take a box, say the right main one, get the distance H from the center of the brass to the front bearing surface, and lay it off on $F\ F$ of the right main jaw, measuring to the front from the center line $E\ E$, thus locating point H^1. Do the same with G, measuring back from $E\ E$ and locating G^1 on $F\ F$. Take each box and repeat the operation for its corresponding jaw. These points H and G show the exact position which the box should occupy in its jaw. By doing this the center line of the box will be kept its box will occupy. Now take each shoe and set it up in its place on the jaw, the set bolt being set up tight, thus holding the shoe firmly in position. The line $K\ K$, passing through H and parallel with $E\ E$, must now be scribed on the outside of the shoe. In order to do this, place two parallel strips across the top of frame, the ends projecting over the edge of the frame. Take a large square and set it on these projecting ends, with the blade hanging down at the side of the shoe; then take a small square, place it on the side of the frame with blade at H, and move the large square until its blade touches the blade of small square. While doing this hold the small square firmly in place and keep the blade of large square pressed against the side of shoe, but be careful and not cramp it so that it will not rest evenly on the parallel point L. Two blocks should also be cut so as to reach the upper point L in the same manner. With the straight edge resting on these smaller blocks, place it so that it is the same distance from L on each shoe. The plan of Fig. 1 shows one block and the end of the straight edge as it rests against the shoe.

Now take your "maphrodites" and set them to this distance, *i. e.*, from the straight edge to L, which is equal on both sides of engine, then lay that distance off on the side of the shoe with the leg of the "maphrodites" placed against the straight edge. Do this on the other shoe on the other side of the engine, then place the straight edge on the long blocks in the same manner and repeat the operation for the upper point L. Scribe a line through these two points just located on the inside of the shoes. This line then



LINING UP SHOES AND WEDGES, LINES AND POINTS REQUIRED.

at the center line $E\ E$ of its jaw, no matter if the box is not bored out central. To get G and H take a piece of lead or a piece of wood with a tin strip set in its surface and place it between the sides of brass bearing, then take "maphrodite" calipers and locate the center of the brass bearing, on this lead or wood piece. A ½-in. plate planed on one side and cut out to the shape shown at Fig. 4 should now be made. This can then be set on the bearing surface of the box, the plate projecting over the side of the box as shown in the plan view of Fig. 3. The distance H or G can then be obtained by measuring from this plate to the center of the brass previously located on the strip of lead. The plate should be made so that it can be used on any ordinary box. It can then be used on any job of shoes and wedges.

To return to the frame: We have now located on each jaw the position which strips. When the large square is properly located, take your scriber and scribe a line along its edge upon the side of shoe, thus locating line $K\ K$. In order to prevent the parallel strips from tipping off the frame on account of the weight of the square, place a piece of iron of sufficient weight upon them as they rest on the frame. Fig. 5 shows the arrangement of the squares and shoe. This operation should be repeated on all the shoes.

The next thing to do is to locate on the inside of the shoe a line corresponding to $K\ K$ and at the same distance from $E\ E$. Take a long straight edge and pass it between the jaws and across the engine from frame to frame. Select two points $L\ L$ on $K\ K$, near the top and bottom of the shoe. Cut two small wooden blocks long enough so that when placed on the pedestal brace (one on each brace), with the straight edge resting on them, it will come opposite the lower corresponds to $K\ K$ on the outside of shoe. Repeat this operation on all the shoes.

If the distance H is not the same on the opposite jaws it will be seen that the above operation is not theoretically correct, but unless the distance H varies greatly it is considered close enough for practice, the error being very small.

After all the shoes are thus laid out, they are taken down and planed to these lines. Before taking them to the planer locate with your dividers a point M, Fig. 6, a certain distance from L on the side of shoe—¾ in. is a convenient distance. It should be laid off from each point L, and a small circle described about it so as to make its position plain. After the shoe is planed, by measuring the distance from the planed surface to this point, it can be seen whether the shoe was planed to the lines laid out. This is called a "proof" mark, because it is

a means of proving whether the shoe was planed as laid out. If this mark is left off, the planer hand can swear that he plained to the lines, and his word will have to be taken.

After the shoes are all planed, set them up in place again; also set the wedges in place on their respective jaws, the wedges being set at their lowest position. Now take a large pair of calipers and caliper the distance between the bearing surfaces of the right main driving box, *i. e.*, $H+G$, Fig. 3. A line K K parallel to the planed surface of the shoe must now be scribed on the wedge, both inside and outside. The handiest and most accurate way to do this is by means of the tool shown at Fig. 8. This consists of a piece R, shaped as shown, the inside surfaces T and R being at right angles to each other. In this piece is screwed a 5/16-in. steel rod, with an offset and a movable point S. The side T has a slot cut in it for convenience in setting the point S to its proper position. Set the point S a distance from the surface T equal to the distance obtained by calipering the box.

Place the squared surfaces R and T against the corner of shoe, the surface T bearing against the bearing surface of the shoe, and the surface R bearing against the outside of shoe as shown. Now slide the tool down the shoe, holding it firmly with the point S against the side of the wedge. This scribes a line K K on the side of the wedge parallel to the planed surface of the shoe and at a distance from it equal to the distance between the bearing surface of the box. Do this on all wedges both inside and outside, being careful to set the point S for each box, then take the wedges down, put on the proof marks and get them planed.

After the wedges are planed, set them up in place again, then place the long straight edge across from frame to frame as before, first rubbing its edge with damp lampblack. Place this edge against opposite shoes or wedges and rub it back and forth a few times, then notice how it bears on the surfaces. By this means it can be seen whether the bearing surfaces of opposite shoes or wedges are parallel to each other or not. To test the work in another way, caliper the boxes again and set the inside calipers and caliper the corresponding shoes and wedges. As a final test after the wheels are placed under the engine and wedges set up in place, the side rods not being up, go to each wheel and plug up the center holes made at the lathe, by hammering lead into them, then with dividers carefully locate the center of wheel, a circle for this purpose being usually cut in the hub of wheel when it is in the lathe; then lightly prick the center. Do this on all the wheels. Now set the large trams to the length of the side rod as before, place one point in center of main driving wheel, and try the center of the next pair of drivers with the other point.

It can then be seen whether the work is right or wrong. Try all the wheels this way with the trams set to the proper length. If the work has been carefully done, the wheels will undoubtedly come all right.

It will be noticed that the point G, Fig. 1 was not used in locating K K on the wedge. It is not necessary to lay in G, but it will do no harm to do so, as the position of K K on the wedge may be compared to it as a proof.

This method of lining up shoes and wedges, of course, cannot be used in all details on some makes of locomotives, owing to their peculiar construction, but it will be found that it can be used on ordinary engines. For instance, in getting the line K K on the shoes by means of the squares and parallel strips, as described, it will be found that this cannot be done on the rear pair of jaws with those locomotives where the fire box sits on top of the frame. Instead of getting K K in the manner described, it may be located by setting the large trams to the length of side rods, as before, and tramming from K K of the main shoe, then K K of the wedge can be obtained as usual.

Composition of Sand.

The writer was one day rambling about a great terminal station looking for amusement combined with instruction. The weather was humid without being rainy and a notable thing about the engines starting trains was the excessive amount of driving wheel slipping. By the courtesy of a good natured engineer, we were able to collect a handful of the sand in use and to carry it home.

Under close examination, the sand proved to consist of thirty-four per cent. calcium carbonate, thirty-nine per cent. of clay and vegetable matter and about twenty-eight per cent. of silica. That mixture made a most inferior sand for the prevention of slipping on wet rails, the silica being the only substance of any value.

At the last Traveling Engineers Convention, there was some discussion concerning sand, and the statement was made that the best sand is made from crushed rock. In fact, all sand is crushed rock, but it makes very much difference the kind of rock that has been subjected to the crushing or grinding process. We understand that there is a silicous rock somewhere in Ohio that is being crushed for locomotive sanding purposes, and that it is very good indeed, as a preventative of wheel slipping. Railroad companies have been astonishingly remiss in their selection of sand, for inferior sand that promotes slipping wastes much fuel and is very destructive to machinery.

The sand usually sold to railroad companies varies very much in composition depending upon the locality where it was gathered. The most common ingredients are silica, calcium carbonate and argillaceous compounds being clay. On the seashore, silicules make up most most of the sand, being the disintegration of igneous rocks, the silica remaining after other minerals more subject to disintegration have been wasted or blown away. Calcareous sands result mostly from the grinding up of shells by the waves. Argillaceous or clayey sand comes from the grinding up of rocks containing alumina. When the mixed sands of the sea are driven inward by the winds, the sand dunes formed are liable to contain a large percentage of calcareous and clayey matter, for these are lighter than silica and are more easily wafted before the wind.

Chemists have no difficulty in distinguishing silica from the other ingredients forming commercial sand. We know of no better means of economy than having all sand offered for sale subjected to expert examination.

The Train Dispatcher.

An esteemed friend, who was once a railroad man but has degenerated into editing an evening daily paper, writes us: "I notice you have been saying some kind words about the 'Train Dispatcher.' Having filled that position for three years, I know something about the trials and responsibilities of the position. Running a newspaper, or any other kind of business, or any other department of a railroad, is simply a picnic, an increasing round of joy and pleasure, as compared with the duties of a train dispatcher. Upon his shoulders rest greater responsibilities than any other man in the service, He is under a strain all the time, and to move hundreds of trains on a single track, make them meet and pass one another, running specials and extras and work trains, and all of that, and engineer them all in safety, and at the same time arranging so that no time shall be lost by any of them, that all connections may be made, and to continue that work, day in and day out, is old making business.

"It is very seldom, indeed, that a telegraph operator or a train dispatcher makes a fatal error in a train order, and then the dispatcher is not oftener to blame than the officials who prepare the form of order. The telegraph operators who make 'bulls' are ordinarily the cheap plugs who are incompetent and are employed simply because they are cheap." If there is any man, or set of men, who are entitled to kindly encouragement, or a holiday, it is the train dispatcher, who as a class are overworked.

Questions Answered

ELECTRICITY FOR HEATING.

W. R., New York City, writes: During the very cold weather in a part of this winter I have observed that the elevated and street cars heated by electricity were kept quite comfortable in spite of the constant opening of doors. It occurred to me that electric heating could be much more generally adapted as a means of heating. The unsatisfactory condition of offices and houses could surely be improved upon. Why do our inventors not find means to apply electric heating more generally? A.—Because of its high cost. When coal is burned in a steam boiler and heat is applied by either heated water or steam, it is not uncommon that as much as sixty per cent. of the heat in the fuel is utilized. When the heat of the coal is used to generate steam at a high pressure sufficient to generate electricity and the electricity is turned back again into heat, not much more than ten per cent. of the original heat is utilized. The coal bills of the Interborough Rapid Transit Company would strike a stranger with amazement. They are bigger than the rake-off of a political contract.

LENGTH OF STROKE.

W. L. C., West Albany, N. Y., writes: Within reasonable limits and in the same kind of service, whether in an engine with a comparatively long stroke and a small diameter of cylinder, or one of larger diameter of cylinder and shorter stroke of piston the more powerful? A.—As the particular kind of service is not stated, it may be said that a short stroke of piston is the best for light fast trains, and long stroke for heavy trains at a lower rate of speed. Much depends also on the diameter of the wheels. At high speeds from 1,000 to 1,200 feet per minute of piston speed is good practice for a train running at a velocity of 60 miles per hour.

SUPERHEATED STEAM.

E. M., Denver, Colo., writes: In superheating steam, why is it that the extra pressure which is given to the steam does not find its way back through the dry pipe into the boiler instead of entering the steam chest at a higher pressure than that of the boiler? A.—There is no extra pressure. The steam is simply heated to a higher degree of temperature, and the fact that the passage way is open to the boiler renders any variation in pressure an impossibility. The steam, after being superheated, contains more heat units than ordinary saturated steam. Hence it enters the cylinder capable of a greater degree of expansion than steam at a lower degree of temperature. Both kinds of steam are fluids in a thin state, but the superheated steam is the drier of the two, and capable of doing more work before being condensed into water.

SAFETY VALVES IN BOILER TESTING.

J. R. K., Jacksonville, Fla., asks: In testing a boiler by the hydrostatic process at 25 per cent. above working pressure, is it good practice to screw down the safety valves to withstand the extra pressure, or remove the safety valves altogether and plug up the openings with wood, and after the test adjust the springs to the working pressure? A.—Both methods may be improved upon by removing the safety valve springs and allow the valves to remain in their places, and place pieces of pipe over the valves, then screw the valve caps snugly down on the valves. The valves will then remain shut against any pressure. It should be remembered that valve springs may be damaged by excessive compression, and as for pieces of wood in the safety valve openings, unless they are tapered plugs and driven from the inside, they are not to be depended upon.

BY-PASS VALVES.

J. G., Fall River, Mass., writes: What is the use of by-pass valves and how do they operate? A.—The by-pass valve is almost similar in construction to a safety valve, and is located in a cage that extends over the part leading from the steam pipe to the space between the heads of the piston valve. The by-pass valve is kept in its seat as long as the pressure in the steam chamber is greater than the pressure in the cylinder. If the pressure in the cylinder should, from any cause, become greater than in the steam chamber, the by-pass valve is lifted from its seat, thus relieving the cylinder and piston and cylinder heads from undue pressure. A slide valve does not require the use of a by-pass valve because the slide valve will readily lift from its seat in the event of excessive pressure in the cylinder. A piston valve, however, having its bearing on every part of its circular surface, cannot so accommodate itself, and the by-pass valve as we have stated, relieves any excessive pressure.

NEGATIVE LEAD.

J. A. L., Boston, Mass., asks: What benefit is claimed for a valve set with negative lead? A.—Lead, or the opening of the valve before the completion of the piston stroke, is claimed by some engineers to cause pounding, and also is the cause of more or less difficulty in starting the engine according to the position that the pistons may be in while the engine is at rest. Negative lead is claimed to avoid these troubles. The advantages or disadvantages of lead has been a subject of much controversy, and the end is not yet. That a limited amount of lead on a high speed engine is an advantage is almost universally admitted, as the speed at which steam moves may be said to be a constant velocity, while the speed of a piston on a passenger engine, is, generally speaking, much higher than that of a freight engine, and hence a preadmission of steam on a high speed engine equalizes the impact at the beginning of the piston stroke and makes it possible that the full force of the steam should act upon the piston before the main crank pin has reached the upper or lower center. The subject is dicussed at considerable length in "The Valve Setters' Guide," published by the Angus Sinclair Company, and sold at fifty cents per copy.

EMERGENCY OR QUICK-ACTION.

G. H. W., Wheeling, W. Va., writes: Can a distributing valve with a plain cylinder cap, go into emergency during a service application? A.—It can get into such condition as to assume quick-action position during a service application, but can make no brake pipe reduction or transmit the quick-action to triple valves in a train.

The expression "going into emergency" is a rather vague and meaningless way of suggesting undesired quick-action. Quick-action is an air brake feature while an emergency is a condition; a triple valve, distributing valve or control valve has a slow application feature for service stops and a quick-action feature for stops in cases of emergency. A brake valve has an emergency position to be used in cases of emergency, but whether quick-action will result from the use of the emergency position depends upon certain conditions other than the mere movement of the brake valve handle to the emergency position. If then, the brake valve handle is moved to service position and due to some disorder, the triple valves move to quick-action, which is shown by the fall of the hand on the brake pipe gauge, we would say that undesired quick-action has occurred, or if the handle is placed in emergency position, and only a service operation occurs, we would say that an emergency application was made and quick-action failed.

Low Pressure of Illuminating Gas.

At Syracuse, N. Y., the city has about 170 miles of gas mains from 2 ins. to 20 ins. in diameter, and the gas pressure varies from 1½ to 3½ inches of water, these being the limits, or, say, 1/20 to ⅛ lb. to the square inch. People accustomed to the ventilation of water and of different vapors in pipes are mystified at the low pressure required to circulate illuminating gas.

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The Southern Pacific Suit.

In its suit to compel the Southern Pacific Railroad to part with control of the Central Pacific the Government goes much further than it has ever gone before in its attempts to dissolve combinations under one ownership of parallel or allegedly parallel lines. When it brought suit to dissolve the Union Pacific-Southern Pacfic merger it had a far more plausible case. The Southern Pacific had a transcontinental line from San Francisco to New Orleans and thence a line by water to New York. The Central Pacific and Union Pacific constituted together another transcontinental line from San Francisco to Omaha and thence East by connections with other roads. The systems were in a certain sense parallel, though lying hundreds of miles apart. The Federal Circuit Court held that the parallelism was not sufficient to constitute an offense against the law. The Supreme Court overruled that decision and dissolved the merger.

Now the Southern Pacific main line is accused of being parallel and competing with the Central Pacific, which starts East from San Francisco and terminates in Utah. A surveying instrument would hardly show that they are parallel, and the Central alone is not in any sense a transcontinental carrier. If it is taken from the control of the Southern Pacific the court will probably act on the theory that it ought to be sold to the Union Pacific in order to give the latter system a completed transcontinental line. But that is a motive for dissolution only distantly related to the charge of being parallel and competing.

Meanwhile the people of California are furious at the Government's interference with the railroads that have done so much to develop this country and are the best guarantee of continued prosperity.

Cooperation of Mechanical and Operating Departments.

At the Twenty-first Annual Convention of the Traveling Engineers' Association, an excellent report was submitted on "Credit Due to Operating Department for Power Utilization and Train Movement That Reduces Consumption of Fuel Per Train Mile."

It was an appeal to members of operating departments to co-operate with the mechanical department in keeping down the consumption of fuel in train movement. The appeal was so forcible that we expected that it would do some good in making greater co-operation between the two departments but we have not been able to detect any improvement. We are afraid that Mr. F. P. Roesch described the true situation, when during the discussion that followed the reading of the report, he said:

"This is one of the most suggestive papers that has ever come before this association, and it is to be regretted that there are not more of the operating department officials here to-day. I question very much whether the officials of the operating department are as much interested in fuel economy as they should be, or realize the fact that they can assist the mechanical department in fuel economy. Of course, we all understand that the general managers, general superintendents and broadminded officials are vitally interested in the subject the same as we are; but when we get down below the rank of general superintendent—of course we will have to include occasionally a division superintendent who is interested. Among the trainmasters, the yardmasters and so forth, I question if they care anything about the quantity of fuel used. All they are interested in is to get maximum tonnage over the road in the shortest time. The yardmaster tries to keep the yard clear; the trainmaster tries to keep his division and side tracks clear.

"This is a matter which ought to be brought before the operating department in such a manner that they would realize that they can do equally as much towards the saving of fuel as the mechanical department; but in order to do that, it will be necessary for the Mechanical Department to show them the manner in which the trains are handled. Of course, this is a delicate proposition in one respect, especially when a road foreman reports to the superintendent of motive power, or is under the jurisdiction of the mechanical department and not the operating department.

"I believe about the only time a chief dispatcher is interested in the amount of coal it takes to handle a freight train over the road is when they run out of coal and it becomes necessary to leave the train to run for a fresh supply. Yet, at the same time, if dispatchers paid more attention to operating conditions, to train loading and such matters, there is no doubt that they could do as much towards saving of fuel as we can.

"Heretofore, the burden has always been put upon the mechanical department, and it is necessary for that department to shift a portion of the burden, if we are going to give credit to the operating department for fuel economy, and the man who can do most towards showing up the real conditions that exist on the line of railroad is the traveling engineer. Take an order, for instance. At one place you have to beat the life out of the engine to make a meeting point, and when you arrive there you have to wait half an hour for the meeting train. Of course, we cannot realize what the dispatcher has had to contend with. There are many conditions entering into this terminal proposition and other things, that we do not bear down on hard enough and do not keep hammering at until we get the conditions relieved; but go ahead and do the best we can towards saving fuel, and let the other fellow get as much of the credit as he possibly can."

We publish this speech of Mr. Roesch's in hopes of directing the attention of the operating department to the real necessity for their co-operation in keeping down fuel bills. Nearly all presidents and general managers are urging greater economy in the use of fuel, and every official ought to do his best to help this highly important movement.

American Machine Tools.

Various forms of American machinery, particularly machine tools, have been for years rapidly gaining favor, by users of such tools, in foreign countries. Although the cost of production is higher here than in Europe, some of our first

class tool makers have been finding a steadily increasing market for their machine products in Great Britain and in different continental countries. American tool makers have devoted untiring attention and shrewd intelligence to perfecting the minutest details of their machines, so that the latter should be thoroughly adapted to the work they have to perform.

Proper adaptability of means to the required end, has been more intelligently studied among our tool makers than among their rivals abroad. The general use of the contract system has stimulated the developing of tools to perform the purpose of their design in the most perfect manner, and our practice of encouraging workmen to invent improvements in the tools they handle, has given our tool makers the co-operation of a vast army of inventors, enjoyed by the manufacturers of no other country. The result is that American machine tools have become more popular abroad than the tools made in other countries, even tool makin Great Britain having fallen far behind in this race of utility. It is not possible to find an automobile making factory in Europe that does not use American tools.

British tool makers for years opposed the tendency of machine users to patronize American tools, by abusing the articles made on this side of the Atlantic, or by sneering at what they called the silly fashion that favored Yankee notions. After a time it was found that abuse and unfounded detraction did not lessen the demand for American machine tools, so some of the more respectable and enterprising British machinists proceeded to take a lesson from their rivals, and a tendency arose among them to imitate American practices. Cut gears began to to take the place of noisy cast gears that were formerly universally used, more attention was directed to constructing machines that would cut down material quickly and accurately, and some care was bestowed upon making the handling of tools convenient for the workman. The old plan was to leave the convenience of the workmen out of account, just as locomotives were and are still built, without the convenience of handling receiving any consideration. The change of policy is increasing the popularity of British machine tools.

The Combustion Chamber.

There has been a tendency of late, among certain master mechanics and locomotive designers, to introduce the combustion chamber to locomotive boilers. During the time that locomotive engines have been in use, many devices have been applied as improvements, found unsatisfactory and abandoned. Then, years afterwards, others have reinvented and even patented the same device and made it work successfully. That being the case there may be prospects of the combustion chamber becoming an economical arrangement for locomotive boilers. The tube arrangement of a steam superheating boiler may make the combustion chamber more useful than it has been with plain tubular boilers.

The combustion chamber was first introduced in locomotive practice and thoroughly tested by James Millholland, master of machinery of the Philadelphia and Reading Railroad about 1850. This was done in connection with efforts made to burn anthracite coal in locomotive boilers. A variety of experiments were made by Mr. Millholland in which the combustion chamber figured. A famous locomotive of that time, the Pawnee, had a combustion chamber at nearly the middle of the boiler, a combustion chamber being in front of the fire box. Flues 3 inches diameter connected the front and the back combustion chambers. The engines did not steam freely and various changes were tried, but eventually the combustion chambers were removed. The decision arrived at by Millholland was that to burn anthracite coal successsfully, a large grate and long flues were necessary.

The locomotive engineering practice of the United States followed Millholland's practice closely, as far as burning anthracite was concerned.

In those days, most of the locomotives in the United States burned wood, for which they used plain deep fireboxes. When wood was becoming scarce, and the burning of bituminous coal was becoming a necessity, inventors began to offer for adoption various novel forms of furnaces and fireboxes, guaranteed to extract the greatest amount of heat out of the coal, along with some heat that was not there. The old Hudson River Railroad took a lead in trying out so called improvements designed for the purpose of burning soft coal properly. Among these devices, the combustion chamber was tried in various forms. It was tried from one foot to five feet long. Large flues and flues as small as 1½ inches were tried in connection with the combustion chamber; while brick arches of various forms were tried to prevent the combustion chamber from filling up with cinders. Various methods were adopted to mix air with the gases of combustion in the combustion chamber. Nothing that skill, directed by zealous intelligence, could do to make the combustion chamber promote steam generation was spared, but without success. When a courageous master mechanic abandoned the combustion chamber and substituted plain flues the full length of the boiler, the steaming qualities of the engine was always improved, and so the combustion fell into innocuous desuetude.

Metric Measurements.

We wonder what there is about the Metric System of Weights and Measures that moves so many persons to become enthusiastic advocates of the French system in preference to those that have been in use for centuries. The strongest advocates of the French system are mostly theorists who can perceive no difficulty in changing from the old system that has stamped itself upon every business in every English speaking country.

For many years before the end of the 19th Century, great confusion existed in the weights and measures used in different parts of France, and about the period of the revolution, the urgency for a uniform system became so great that it was pressed upon the attention of the French government. That was a period when the reform and regeneration of mankind was deeply appealing to the attention of French philosophers. That class was highly powerful in France those days, and its members were ready to exude from their inner consciousness anything from a new religion or government to a new vice, and the furnishing by them of a new metrological system was a mere bagatelle. They took, as the unit of their system, what they incorrectly calculated to be the forty-millionth of the earth's meridian, which passes through Paris. This they called the metre. Its length is a trifle over 39.37 inches. Its divisions and multiples vary in a ten fold ratio. The first division by 10 makes a "decimetre, 3.937 inches. The second division makes a "centimetre," 0.3937 inch. The third division makes a "millimetre," 0.03937 inch. The multiple makes in succession, "dekametre," "hektometre," "kilometre," and "myriametre," all increasing 39.37 inches by ten times. The cubic measures and the weights also have units based on the metre.

After a long struggle, this system was forced upon the French people. In the different States that compose Germany, great diversity existed in the weights and measures, and by degrees, the metric system was adopted to bring about uniformity; but the change caused very great inconvenience for years, more especially in machine shops where lathes with inch measured head screws are still largely used.

Practically all European countries, except Britain, adopted the metric system, but they had at this time, little commerce and less manufactures to be thrown into confusion by a change of metrology. Great Britain, with its immense machine making industries and its varied manufactures, never thought seriously of changing from the inch unit.

If the proposal to introduce the metric system into the United States had been pushed in the beginning of the last century, the change might have been effected with little inconvenience or expense; but there are now so many industrial processes established on the basis of the inch, foot, and yard measurement that a change would ruin thousands and would create intolerable confusion to nearly the whole people. All the land in this great country is divided up into parts measured by the foot or its multiple. To apply the metric system to the description of our town lots alone would lead to a useless increase of figures that the people would not endure.

But it is when we enter the machine shop and factory that we can thoroughly realize the stupendous nature of the change proposed. For more than a century, our mechanics have been laboring on the establishing of interchangeable parts in all lines of machine work, and the parts have been formed on the basis of inch measurements. There are in our workshops millions of tools made to standard sizes based on the inch. Our standard system of screw threads, the most perfect system in the world, is based on the inch, and the vast plants of machinery, designed to produce our great variety of screws, would be lost if a change of standard were introduced. Many advocates of the metric system say that they do not expect a change to be made in established standards.

Let us see how we would apply new names to the old sizes. The successful operating of a machine shop depends in a great measure on sizes being readily understood. When a mechanic examines a drawing, it is of the greatest importance that the size he is going to put into wood or metal should come to his mind readily, without study or calculation with marking materials. The fewer figures that he has to mentally grasp in a measurement, the less chance there will be for a mistake. A common job in a machine shop is to make a bolt 1 7/16x6¼ inches, with taper 1/16 in 12 inches. A machinist reads that on the drawing, and his familiarity with the 2-foot rules enables him to proceed with the work without an instant delay in making calculations.

The metre scale cannot be used in machine shop work, because nearly all measurements are less than one metre, and the use of that scale would lead to no end of decimals. Therefore the millimetre scale is used in practically all machine shops where the metric system is in use. By this scale, the bolt mentioned would be described as 36.5125x 158.75 m.m., taper 1.5875 in 304.8 m.m. If the machinist was as familiar with the millimetre scale as most of our men are with the inch scale, it is obvious that the increased number of figures employed would increase the liability to make a mistake. Where a system of measurement requires many figures, it prevents people from memorizing dimensions, and consequently it calls for more time to do work.

The Master Car Builders and the Master Mechanics' Associations have adopted certain standards that are used by all the railroads in North America. The leading dimensions of those standards have been memorized by the persons having to design and make them. The few figures required in expressing the dimensions in feet and inches are easily remembered. Put the dimensions into the metric or millimetre scale and memorizing become much more difficult. Take the m.m. standard axle A for instance. The total length is 6 feet 11⅝ inches. In the metric scale the length is 2 m., 1 d.m., 1c.m., 4.57 m.m., or 2.114 57 m.m. The journal is 3¾x7 inches. That expressed in the millimetre scale is 95.25x 117.8 m.m.

Every other item of shop measurement about any part of shop work would be subject to similar strange working changes which workmen would learn very slowly at the expense of endless mistakes. Leading advocates of the metric system say that standards would be adopted, which would conform to even divisions of the metre. The proposal to change established forms to suit a new unit of measurement is simply absurd, and the men who speak of such a thing merely display their ignorance of the nation's business. Look carefully through a well equipped tool room, and note the great variety of drills, taps, dies, reamers and gauges that are all made to standard sizes; then reflect upon the thousands of shops and factories that are working to the same sizes. Look at all the lathes in the country, all of them made with lead screws arranged to cut seven threads to the inch or fraction thereof.

No man of good sense, who is familiar with the production of machine work, would venture to recommend that a mixed system of manufacture be introduced into a shop. You cannot have one machine cutting 5 threads to the inch, and another cutting 32 threads to the decimetre, which is the nearest metric unit to the inch; for they will not interchange. It needs no waste of words to impress upon railroad men the confusion that would ensue from mixing of nuts and bolts having threads that are nearly the same but not near enough to interchange. The ancient confusion that existed in car interchange before standard screw threads were introduced, would have been harmony compared to attempting a change under modern conditions. Even if it were an advantage the time for such a change has passed.

Development of the Sight-Feed Lubricator.

A person does not require to be very old to remember the introduction of all improvements made to facilitate the operating of the locomotive engine. The writer is still in working order and his memory records practically all the improvements carried out. When he first began firing the only parts provided for operating the locomotive were a throttle lever, a reverse lever and a pair of pumps. There was not even a steam chest lubricator of the simplest character. The steam pressure was one hundred pounds to the square inch, which was considered sufficiently cool and wet to do its own lubricating.

The development of the automatic steam chest lubricator forms an interesting chapter in locomotive history. The first move in this direction was the placing of oil cups on top of the steam chest which had to be operated by hand, the fireman enjoying the exciting privilege of going forward occasionally and opening the cock of the steam chest oil cup. A great improvement upon that practice was placing oil cups in the cab from whence pipes let the lubricant to the steam chest. The hydrostatic lubricator with continuous feed, operated by a water-column derived from steam condensation, has been used in marine and stationary engine practice since about 1870. The up-draft sight-feed feature in the same form as used at present, in which the oil rises in drops through a column of water was invented in 1870 by John Gates, then chief engineer of the Oregon Navigation Company. These early lubricators were not adapted to locomotive service, since their proper operation depended upon the equality of pressure at points of steam inlet and oil outlet, but there was nothing in the construction of these lubricators to equalize the pressure, and the result was that when placed upon a locomotive, they could not be made to work on descending grades when a partial vacuum existed in the oil pipes. Not only would they fail to operate properly with differential pressure, but the oil would be sucked out of the vessel, rendering the lubricator inoperative, even after the steam had been turned on.

The constant aim of inventors had been to design a lubricator apparatus which should deliver the oil continuously to the cylinders, whether the engine was working light or hard, whether it was working steam or drifting with a closed throttle. Some approach to this perfect condition had been achieved, but some small defect always obstructed perfection; still progress was making.

Few lines of engineering invention were engaging so much attention as the cylinder lubricator, when in 1876 Nicholas Seibert suggested the necessity of equali-

zing the differential pressures in a locomotive lubricator and secured a patent for an equalizing pipe arrangement. Although he had conceived the right idea, Seibert failed to perfect the invention and others began to labor in the same field. Several years elapsed, brimful of experiments without notable results, until in 1882 the discovery was made that the proper means of equalizing the differential pressure was by choking or obstructing the steam passing from the equalizing pipe in the steam chamber at the discharge of the lubricator. With this discovery, the success of sight-feed lubricators for locomotives was assured, and its rapid development followed, the improvements introduced since the choke plug was applied being matters of detail, such as the oiling of both steam chests and the air pump from one lubricator.

Iron and Steel Making.

The basis of all iron and steel manufacture is iron ore, and of the forms in which it occurs, the oxide is of the most service to the steel industry. This ore is the element iron combined with oxygen and containing quantities of various other impurities, such as silicon, sulphur, phosphorus, etc. It is the content of the phosphorus in those ores which determines whether or not they are Basic or Bessemer; that is, whether the ore can be made into pig iron, suitable for the Bessemer converter or the Basic open hearth furnace. The Bessemer process does not permit the elimination of sulphur and phosphorus beyond certain limits and this is true down to the finished sheet. Therefore, it is necessary in order that the finished product may be of superior quality that we must go back to the ore, determine the amount of sulphur and phosphorus which is contained therein, deduct what amount is supposed to be removed by the furnace operations, and thus determine whether the ore is suitable for Bessemer steel or not.

The Basic process is capable of utilizing the ore rejected by the Bessemer, and produce an equal and even superior finished product, but there are some ores which neither process can successfully treat, and unless careful watch is maintained on the ore supply, there is ample opportunity for some of this low grade ore to find a way into the market, in some form of iron or steel, which will result in the latter's speedy failure. It will not be necessary to go into the detail of blast furnace methods. We are generally speaking of four kinds of material put into the blast furnace fuel, iron ore, fluxes and blown air. Four kinds of material are discharged from it, pig and slag, tapped from the lower part of the furnace and gas and dust which pass out through the top of the furnace. The solid materials are charged in the regular way and in alternate layers, coke is the fuel most generally used. As the iron is formed in the furnace, it drops to the lowest portion of the hearth from which it is tapped after four hours, and is either cast into pigs or transferred in the form of hot metal to either the converter or open hearth furnace.

Let us follow some of this hot metal to the Bessemer converter. This large pear-shaped vessel is lined with refractory material and the molten metal is poured in at the top. A current of air is passed through this already highly heated material, oxidizing the silicon, carbon and manganese in the metal bath, and causing an increase of the temperature until the point is reached when the metal has been purified to a degree which makes it acceptable to a certain class of purchasers. We will now return to the blast furnace and take note of the pig iron which has cast either in sand or in pig iron machines. It is sold to Bessemer or open hearth steel manufacturers who do not have a blast furnace in connection. Either hot metal from the blast furnace or cold cast pig iron together with scrap iron and the necessary fluxes are placed on the hearth of an open hearth furnace and melted by the heat of gas made in producers from coal or by natural gas when it can be secured.

Blind Punishment.

The days are happily long gone by when a railroad officer suffering from an attack of spleen would exhaust the accompanying evil temper in the discharging of men without cause. That cannot be done nowadays without the violator of justice being called to account by officers superior to him in every way. Still there is too much tendency among many railway officials to inflict punishment for slips of discipline or for supposed slips that is by no means weighed on the side of mercy. The difficulty in January last with the employees of the Delaware & Hudson Company, that resulted in a strike, was a fit illustration of the case we are trying to make out. Extreme want of judgment on the part of an official who discharged an engineer and conductor for an offense that want of experience on the part of that official magnified into serious proportions, roused the rank and file of the road into fierce hostility that nothing but a strike could satisfy.

Here is one of many cases that come to our attention where the fool killer has missed an official clothed with the authority to inflict punishment for imaginary offenses:

"One of the large engines, equipped with a brick arch, 70½ inches in length, beginning about five inches from throat sheet, taking up nearly the entire width of firebox (69 inches). Engine made trip of 188 miles without showing a sign of damage, was inspected at ash pit by engineer and inspector, showing nothing wrong whatever, fire was drawn and engine put in round-house, where boiler test was made (hot water test).

"Working steam pressure 205 pounds. When test was made about 40 crown bolts developed a leak at 247-pound pressure. After calking these bolts the engine was again put on her run.

"Engineer states that he had a smooth, even run. Engine and injectors worked perfect in every detail, at no time was he compelled to push the engine more than usual, and no time during the trip did he have water below the usual level.

"However, after about three weeks he was advised that he would be suspended 30 days for being responsible for these bolts leaking.

"Superintendent of motive power claims that water was allowed to get low enough to cause the scale to loosen, causing this trouble."

The claim of the S. M. P. is a mere theory which should be indulged in very carefully in the case of stay bolt leakage. There are so many unidentified causes for staybolts leaking, that it is unjust for an official to inflict punishment unless there are indications that the sheets were overheated and no proof of any kind was forthcoming that such overheating had taken place.

Master Mechanics' Annual Report.

Circular K issued by Secretary Taylor of the American Railway Master Mechanics' Association reads:

The Report of Proceedings for 1913 has been distributed to the members. In order that you may supply such of your officers as may require them, an addressed postal card is enclosed herewith on which to order the additional copies necessary. The report this year is so voluminous and the expense of preparation and printing so much greater than before, that it is necessary to increase the price to $5 per volume. The reports of committees this year were unusually thorough, indicating that they did their work well. Under the head of specifications, recommendations were made for cast-steel locomotive frames, main and side rods, steel tires, boiler tubes, safe ends, arch tubes, and engine and tender wheels. The reports on design, construction and maintenance of locomotive boilers, smoke prevention, tests of superheaters, both at Purdue University and at Altoona, Pa., by the officials of the Pennsylvania Railroad Company, as well as the history of the development of the three-cylinder locomotive, are the most interesting ever presented, so that this year's report is the best ever issued, and, as our good friend, Dr. Angus Sinclair, says, "As they grow in age they grow in merit."

Elements of Physical Science

By JAMES KENNEDY

III. MOTION.

Motion may be said to be either absolute or relative. The former is a change of place with a reference to a fixed point. The latter motion has reference to a point that is itself moving. The motion of two balls rolled on the floor is absolute. Their motion with reference to each other is relative.

Rest is the opposite of motion, and has also the two relative qualities of motion. For example, a body resting upon the earth may be said to be absolutely at rest. A body resting upon a moving body, is at rest relatively to the other bodies similarly situated. It may be added that although the earth is passing through space at the rate of over eighteen miles per second, all bodies having no other motion than that of the earth, are regarded as being absolutely at rest.

Velocity is the rate at which a body moves, and the velocity of a body is found by dividing the space passed over by the time occupied in passing. It is interesting to note the varying velocities of a few common objects: A man travels four miles an hour, an express train runs fifty miles an hour, sound travels through space seven hundred and sixty-four miles an hour, while electricity, conducted in a copper wire, will flow two hundred and eighty-eight thousand miles per second, or nearly twelve times around the earth in one second.

There are three kinds of motion,—uniform, accelerated and retarded. Uniform motion is that of a body moving over equal spaces in equal times. Accelerated motion is that of a body whose velocity increases as it moves, as in the case of a ball dropped from a height. Retarded motion is that of a body whose velocity diminishes as it moves, as in the case of a ball rolled over the ground.

IV. MOMENTUM.

Momentum is the quantity of motion in a body, and is found by multiplying the velocity of a body by its weight. Thus, if a ball weighs twelve pounds, and travels at the rate of five hundred feet per second, the ball has a momentum of six thousand pounds. It will thus be seen that momentum depends on both velocity and weight, and so by increasing the velocity to a sufficient degree, a small and light body may be made to have a greater momentum than a large one. This is readily understood by comparing the force of a small bullet of lead, fired at a high velocity from a gun and the force of a large iron ball thrown from the hand. On the other hand, a large body, possessing weight, though the motion be hardly perceptible, may also have enormous momentum, as in the case of an iceberg which will crush a ship to pieces. It may be remarked that two bodies moving with the same velocity, have momenta proportioned to their weights, and two bodies of the same weight have momenta proportioned to their velocities.

In comparing the momenta of different objects, their weight and velocities must be expressed in units of the same denomination. If the weight of one is given in pounds, that of the other must be given in pounds also. If the velocity of one is given in so many feet per second, that of the other must be expressed in feet per second. When different denominations are given, they should be reduced to the same denomination.

V. STRIKING FORCE.

The striking force of a moving body is the force with which it strikes a resisting substance. It is apt to be confounded with momentum, but two moving bodies may have the same momentum, but differ greatly in their striking force. The momentum, as already stated, is ascertained by multiplying the weight of the moving body by its velocity. The striking force, on the other hand, is ascertained by multiplying the weight of the moving body by the square of its velocity.

As an illustration, if we suppose a locomotive engine moving at a velocity of fifty miles an hour, and another engine of the same weight moving at the rate of ten miles an hour, the striking force of the former will not be, as may be at first supposed, only five times that of the latter, but it will be twenty-five times greater, as the square of fifty is twenty-five hundred and the square of ten is one hundred, therefore the ratio is twenty-five to one. This fact has been repeatedly demonstrated, not by locomotive engines striking bodies for the sake of experiment, but by smaller and more easily calculated collisions.

In the case of bodies having the same momentum, but varying in striking force, let us suppose a train of cars, the total weight of which, including locomotive and tender, being five hundred tons, moving at twenty miles an hour, and another train weighing two hundred and fifty tons moving at a velocity of forty miles an hour. Both trains would have a momentum of ten thousand tons. But by squaring their varied velocities, we will find that the proportion would be as four hundred to sixteen hundred. That is, the train moving at forty miles an hour would strike a blow four times heavier than the train traveling at twenty miles an hour, even while it is only half as heavy as the slow moving train.

It should be remembered, as we have already stated, in all calculations of this kind it is necessary, when different objects are to be compared, their weight and velocity must be expressed in the same denomination. If the weight of one is given in tons, that of the other must also be given in tons. If the velocity of one is so many miles an hour or feet per second, that of the other must be expressed in the same manner. If different denominations are given, they must be reduced to the same denomination.

Railroad Mechanical Engineering.

In the first year of the 20th Century, a college professor, whose line of instruction had been strictly academic, made a speech at the annual meeting of the Southern Railway Club, and among the highly practical remarks made were:

"Courses of railroad engineering which the universities of the country are offering now, are not merely a fad of the times, they are simply the evolution of what has become a necessity. In old days, when the Pennsylvania railroad was first beginning to have some of its prestige, it is a known fact that in some of the railroad shops there, when a piece of iron broke they simply substituted a larger piece. That is a matter of history. The idea of computing the stress and strain of small pieces in their engineering plans did not occur to them. Finally the civil engineering graduates of the Rensselaer Institute at Troy began to get employment on the Pennsylvania railroad, and it was very soon noticed that these graduates going into the engineering department were forging rapidly to the front, and many began holding offices on the roads. Pennsylvania railroad history is only the history of a great many railroads in the United States. Civil engineers and mechanical engineers have received more rapid promotion than the office men. Of late years, of course I am not familiar enough with the subject to speak knowingly, but I still believe in this time of advancement along all industrial and manufacturing lines. A man who is not a mechanical engineer in the railroad business is generally seriously handicapped. As far as that is concerned, it is becoming so in nearly every profession, that mechanical engineering is somewhat of a necessity for a proper understanding of any kind of manufacturing profession."

Air Brake Department

No. 14 E. L. Locomotive Brake.

The electrification of steam railroad terminals where freight and passenger service is exceedingly heavy as well as the requirements on a growing number of electrically operated roads has resulted in the development of the modern high power electric locomotive for handling both freight and passenger service.

In order that these locomotives may be provided with a reliable and efficient brake, which would embody the operative features and advantages of the Westinghouse No. 6 E. T. equipment, now almost universally standard for steam road locomotives, the No. 14 E. L. equipment is now furnished. This is an adaptation of the No. 6 brake to the conditions of electric service. It may be applied to any electric locomotive, whether used in high speed passenger, freight or any kind of switching service without change or special adjustment of the brake apparatus.

Instead of the steam driven compressor, two electric or motor driven compressors are used to furnish the supply of compressed air and an electric compressor governor replaces the usual pump governor of the No. 6 equipment. Other details as to reservoirs, gages, brake valves, pressure controllers and distributing valves are identical with the No. 6 brake except in certain minor details which are hereinafter noted.

Brake valve manipulation and brake operation conforms to the rules and instructions governing the operation of the No. 6 E. T. brake, and as this magazine has contained some reference to the E. T. brake in nearly every issue during the past six years, either in article or question and answer form, it will not be necessary to repeat any portion relating to operation or construction save where there are slight modifications necessary to this class of service or, rather, type of motive power.

It will be understood that electric locomotives are designed to operate without the use of a turntable, hence there is an operating mechanism at both ends of the locomotive which requires a double brake equipment as to brake valves, gages and pressure controllers.

Safety valves are connected with the main reservoirs as a protection against the possibility of a compressor governor becoming inoperative and but one distributing valve is used.

The K-14-A brake valve used with this equipment is a combination of the form and features of the H 6 and S 6 brake valves, the independent portion being mounted upon an extension of the upper case of the automatic portion. Connections to the independent portion are made through ports in the automatic portion, but all of the operating features are retained. It will also be noted that a distributing valve operated by brake valves at either end of the locomotive necessitates unusual lengths of application cylinder and release pipes regardless as to the location of the distributing valve, consequently an added volume of the application cylinder and release pipe is encountered, the effect of which would be a lower application cylinder pressure and brake cylinder pressure than the standard obtained for a given brake pipe reduction unless a special provision is made to offset the effect.

Similarly an added volume in the release pipe would cause a considerable drop in application cylinder, and consequently brake cylinder, pressures under certain conditions where holding position of the brake valve is used after an automatic brake application.

The added volume of the application cylinder is supplied through a compensating port *w* in the brake valve which adds to the application cylinder pressure while the automatic portion is in service position, therefore no changes in distributing valve reservoir volumes, addition of cut-out cocks or changes in manipulation are necessary.

The effect of the lengthened release pipe is offset by port *f* in the slide valve and seat of the equalizing valve of the distributing valve. When the equalizing portion moves to service position, the port *f* permits a restricted flow of brake pipe pressure via cavity *y* in the graduating valve, port *k* in the equalizing valve and port *i* in its seat to the distributing valve release pipe. This also serves as a quick service feature for the distributing valve. In all other respects the No. 14 distributing valve is similar to the No. 6, the feed valves and reducing valves are of the well known B 6 and C 6 types.

As previously stated, all that we have printed in the way of manipulation, operation, disorders, tests and remedies for the No. 6 equipment will apply to the No. 14 E. L. if the slight modifications of the brake valve and distributing valve are borne in mind and motor driven air compressors and electric governors will be dealt with under a separate heading.

It will, however, be understood that while one of the brake valves is in use the brake valve cut-out cock under the other is closed and the valve handles removed. The handle of the automatic portion can only be removed while on lap position and the independent portion when in running position, therefore the rotary valves of the brake valve will remain in the desired position and not interfere with the operation of the brake valve in use.

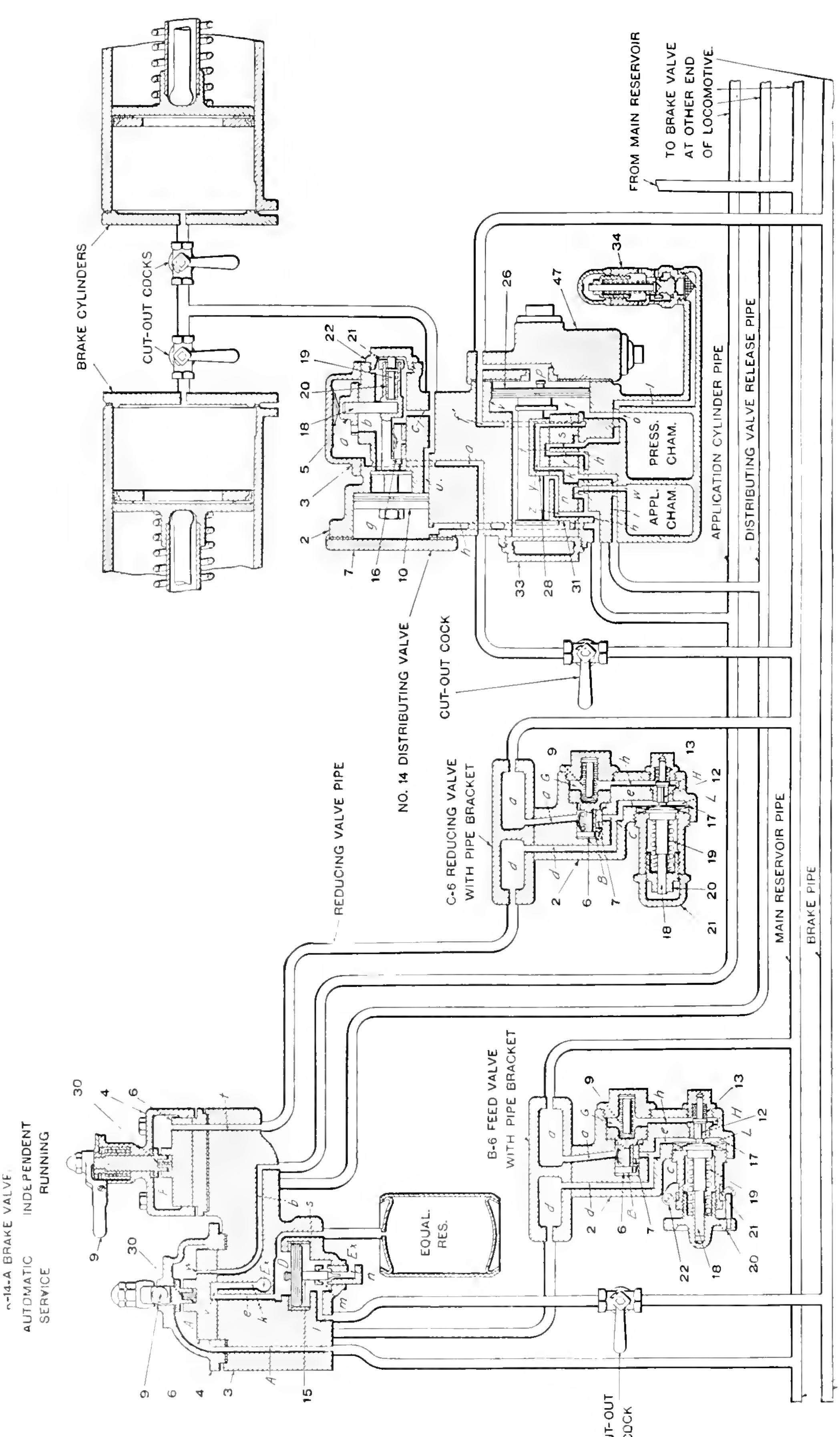
While this is the standard arrangement, it follows that the equipment can be altered to meet any special requirements in electric service.

Passenger Car Brakes.

During our description of the universal valve for passenger car brakes, it was desired to deal chiefly with the operation of the U. E.-12 control valve, and point out the necessity for electric transmission of the operator's intent. At the present time we wish to comment upon the necessity of such air brake equipments as the P. C. (passenger control) and U. C. (universal control) in order to provide an adequate brake control for modern heavy passenger cars.

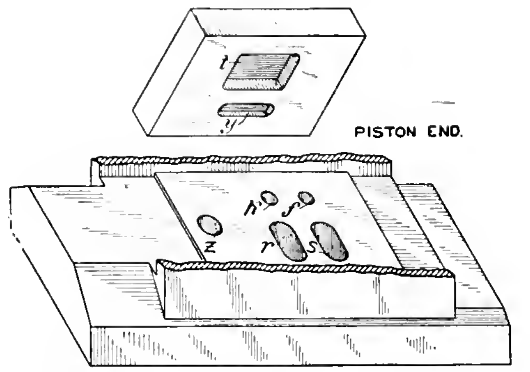
It is now generally understood that the P. M. or triple valve equipments can no longer meet the exacting demands of present-day passenger service, principally because there is no assurance that quick-action or emergency application can be obtained even after a very light service reduction, which impairs the safety feature of the brake. There is no protection against a loss of train control resulting from leakage or incorrect manipulation. The number of applications that may be made without recharge are limited. It is impossible to graduate the release, final service and emergency braking power is practically the same and all the compressed air for the recharge must come from the brake pipe. As compared with modern brake equipments it has other shortcomings which have to some extent been improved upon in the L. N. and Type J. equipments, but at this time we will try to explain to those of our readers who are interested in these matters, why the application of a triple valve equipment is impractical on modern heavy passenger cars.

In applying a brake system to a car, the total leverage ratio must first be considered because briefly, the higher the leverage, the longer the distance the brake cylinder piston must travel to bring the shoes against the wheels or everything else being equal, the distance the piston must travel to apply the brake increases directly with the increase of leverage ratio. As an example, if the cylinder

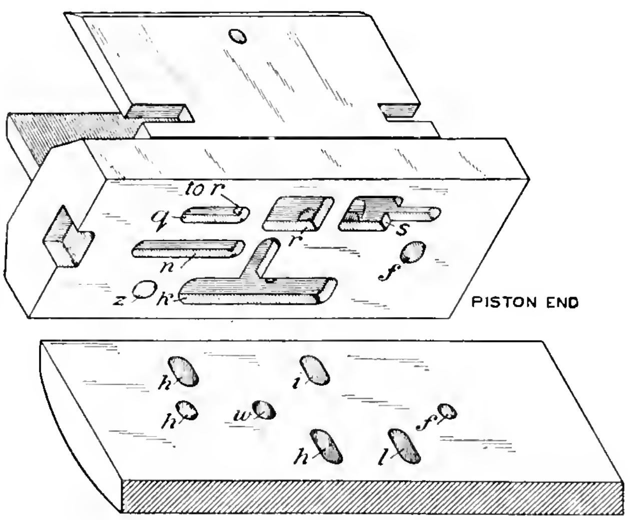


ONE END ARRANGEMENT OF THE NO. 14, E. L. EQUIPMENT.

value (pressure on piston) were to be multiplied 20 times through or by the leverage to produce the required braking force of the shoes, 20 inches piston movement would be required to produce 1 inch shoe movement, or if the shoes were one-half inch away from the wheels, the piston would travel 10 inches in bringing them against the wheels, hence the total leverage is limited to what is termed 9 to 1, that is, a cylinder of such size that is value need not be multiplied over 9 times is recommended.



TOP OF SLIDE VALVE AND FACE OF GRADUATING VALVE



FACE OF SLIDE VALVE AND SLIDE VALVE SEAT

EQUALIZING SLIDE VALVE AND SEAT, NO. 14 DISTRIBUTING VALVE.

Several years ago, when the weights of cars very nearly approached 150,000 lbs., a very complex problem was presented as recommended practice as to total leverage ratio required a brake cylinder larger than 18 ins. in diameter, or one smaller cylinder for each truck. A larger cylinder was considered impractical, not only because of the excessive weight of suitable pistons and rods and the loss of power necessary to operate them, but it is very difficult to find a steer with a hide large enough to contain a 20-in. leather of uniform thickness. A brake cylinder on each truck means two complete brake equipments on each car and double volumes of compressed air to be transmitted.

Among the factors that render brake design and brake manipulation a difficult problem, the most insistent and persistent is the time element incident to the transmission of large volumes of compressed air and the troubles from stuck brakes and flat wheels on double equipments, due to no other causes than the natural effect of handling large volumes of air, serves to illuminate the wisdom of the air brake builders in offering the P. C. and U. C. brakes for heavy cars instead of double equipments.

About the time this brake design problem reached an acute stage several large railroad systems discovered the fact that their passenger trains could not be stopped from high rates of speed in reasonable distances, and the brake manufacturers being called upon to design an efficient brake for heavy passenger cars, found that the demands upon the triple valve exceeded its capacity, or that the limit of triple valve development had been reached, hence the improved equipments to meet the demands.

The P. C. equipments which is a two-cylinder but not a double equipment, has made it possible to stop trains of modern heavy passenger cars from 60 mile per hour speeds in 1,100 feet distance. One brake cylinder is used in service operation and both in emergency, or double braking power is provided for emergency stops. The necessity for the 20-inch cylinder is eliminated by the service brake cylinder pressure being raised to 86 pounds, accomplished by the expansion of compressed air from a pressure chamber into an application chamber which operates an application portion similar to a distributing valve on a locomotive and service brake cylinder pressure is thus obtained and maintained against leakage up to the capacity of the service reservoir. The braking power then being based upon an 86 pound cylinder pressure, obviates the necessity for an immediate increase in the size of brake cylinders as the car repairing the 20-inch cylinder can, with a slight change in leverage, be supplied with two 16-inch cylinders, as this cylinder with 86 pounds pressure is very nearly of the same value as a 20-inch cylinder would be with 60 pounds pressure.

The principal improvement over the triple valve is that the P. C. brake is certain and uniform in action, as brake cylinder pressure is governed by the comparative volumes of the pressure and application chambers, hence its efficiency is not materially affected by unequal piston travel or leakage. There is also a graduated release, and quick recharge of reservoirs preparatory to a second or subsequent reductions or applications and only the actual brake pipe volume need be restored to accomplish a release.

At the same time it combines the minimum sensitiveness to release consistent with stability, and will not apply due to fluctuations of brake pipe pressure, as is the inevitable result of leakage and defective feed valves on locomotives.

As to emergency action, full emergency pressure is obtainable at any time after any service application, and is applied automatically upon a predetermined reduction of brake pipe pressure after equalization. Emergency pressure is approximately 100 per cent. greater than service, and is obtained in the least possible time.

This brake contains practically all of the improved features that can be desired, but they are fixed and unchangeable with the exception of the graduated release, which can be used or dispensed with at will. With some changes the valve can be electrically operated; such valves are known as the E II valve, but are not used in steam road service.

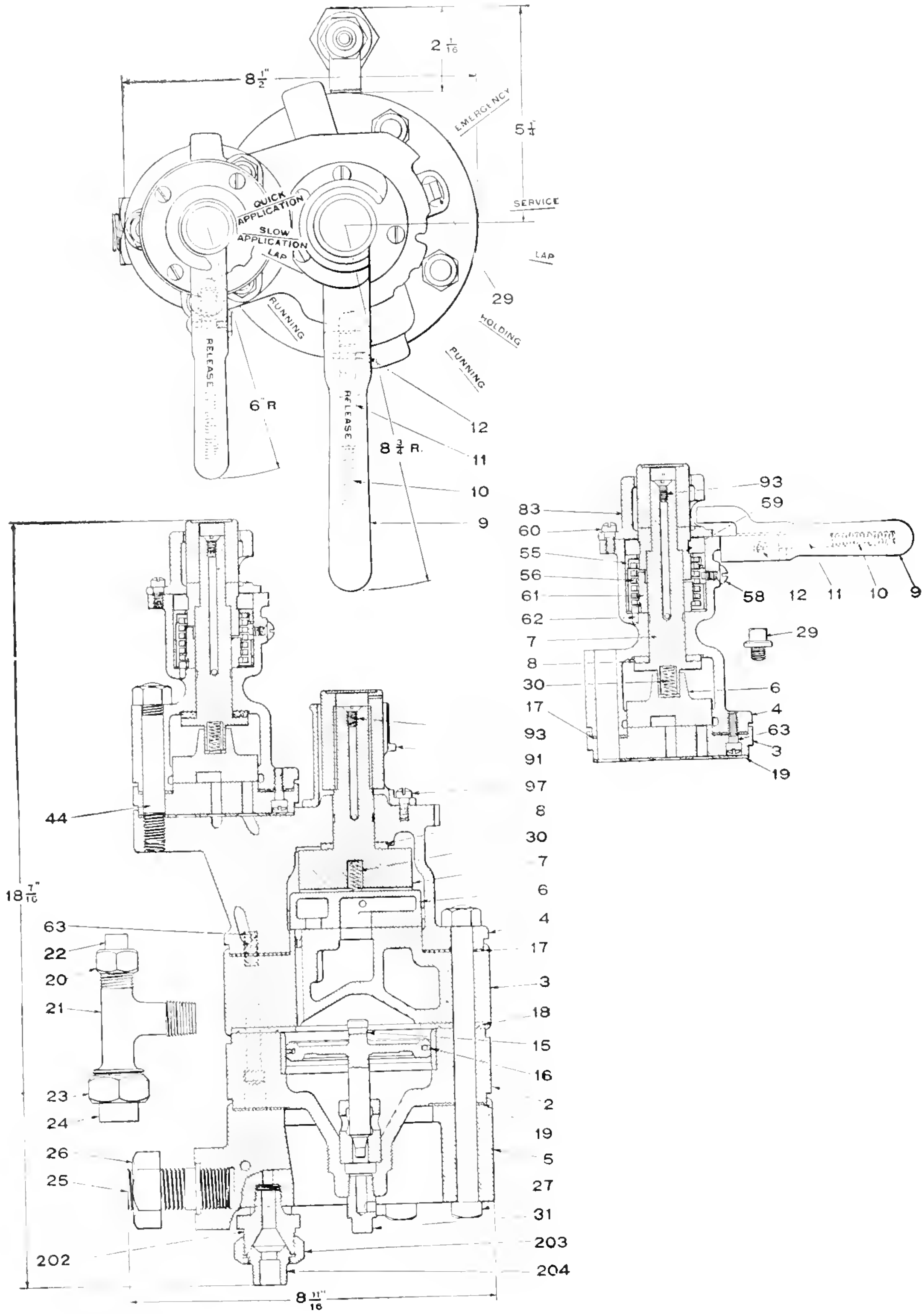
As electric transmission of the application and release of brakes is very desirable in steam road service, the U. E. equipment was developed and is used by the Pennsylvania Railroad, and we have described and illustrated this type of

brake, which the Westinghouse Air Co. hope to make a standard passenger brake for all railroads for a number of reasons.

First, because it will mean one size of valve for all cars, the rate of increase of undesirable, so far as they are known, and is really the result of an analysis of every air brake disorder known to experts.

The brake is so designed that any feature can be used or dispensed with at will by simple changes of parts or by addition, substitution and elimination the brake can manifest any feature or combination of features from a plain triple valve to the most perfect pneumatic brake ever devised and containing electric transmission of the operator's intent.

This is accomplished by merely replacing the features not desired by blank caps instead of the portions containing them.



K-14-A. BRAKE VALVE.

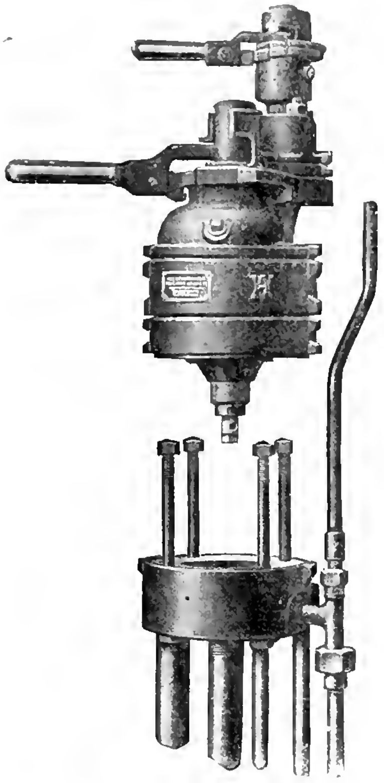
brake cylinder pressure and the exhaust being governed by the passages in the bracket, which is a fixture on the car. It contains all the desirable features of previous brake systems and eliminates all the

The universal valve without the magnet bracket portion or without electric attachments is known as the type U. C. and with electric connections is known as the

U. E. and the valve that will be referred to in future issues will be in the U. E. No. 12.

The equipment permits of either one or two brake cylinders per car; that is, one for service and both for emergency.

By thus adding to or subtracting from the various parts of the universal equipment, about 13 different combinations can be formed in which any feature desired can be obtained and any not desired can be omitted or replaced with another that may be considered of particular value.



BRAKE VALVE REMOVED FROM BRACKET.

Unequal Braking Power.

Why unequal braking power is so likely to cause slid flat wheels is not always understood by those directly concerned. Unequal braking force causes differences in speed between various cars in the train, and besides causing shocks, it permits a condition of slack action that will, under certain conditions, either slide wheels or break the couplings. When one portion of a train starts to run away from another portion, the fastest portion must instantly slow up to the speed of the slower or the slower must instantly be accelerated to the speed of the other, otherwise the couplings must part. During such a time a car with its brake applied may be accelerated to equal the speed of a faster moving car or cars, when through a mechanical law the wheels can not be started to revolving as fast as the car body is temporarily moving, consequently the adhesion between the wheel and the rail is broken and the wheel locked by the brake shoes and slid flat wheels are the result if the distance to the stop is sufficient.

Rough Stops.

With heavy trains and fast schedules, it is frequently up to an engineer to make more or less rough stops or lose time.

The usual practice in keeping on time is to drive in close, to the point of desired stop, and make a full service reduction.

Under some conditions this is all right and sometimes it may be all wrong if the comfort of the passengers is to be considered.

A smooth stop is made with a split reduction, allowing time between reductions for slack to adjust itself, and completing the stop with a low brake cylinder pressure regardless as to how it is obtained.

This will mean a longer time and an increased distance of stop, and while the company may demand fast time and short stops, smooth braking and the shortest possible stop do not come together.

Slid Wheels.

Epidemics of slid flat wheels in passenger service usually come with bad weather, but are not always due to excessive braking power during the stop. The sliding due to brakes failing to release is confined almost entirely to triple valve equipments, however with any improved equipment, the more efficient the brake, the nearer the approach to the point of wheel sliding.

This will not serve as an excuse to cover all cases of sliding because wheels can be prevented from sliding during ordinary service stops. It may entail a loss of time and necessitate three or even four applications to the stop in extreme cases of bad rails, but if the flat wheel is preferable to a loss of a few minutes time during certain conditions of weather, so be it.

In cases of emergency, wheel sliding cannot be considered as it may be trifling compared with the damage that might otherwise result.

Train Handling.

Recently the writer heard one of a number of railroad men quoting Mr. Turner as having stated that in air brake practice no two trains handle alike. Mr. Turner may have done so, but we have heard him say that the same train scarcely ever handles twice alike. Had he ended here we might not yet know just what he meant but he continued and stated, "This is true when the manipulation is the same on the part of the engineer. If he makes allowances for the varying makeups and conditions of the train, the train would handle alike but the manipulation would be different. In other words, we should reserve the present order and vary the operation and thus produce like results notwithstanding the different conditions."

Quite a hard doctrine and not nearly so simple as if merely quoted in spots.

Passenger Brakes.

It is interesting to note that three largest systems of the east have selected different types of brakes for their heavy passenger trains. The Baltimore and Ohio uses the L.N. equipment, the New York Central the Passenger Control, and the Pennsylvania has adopted the Universal equipment.

The Interborough, being compelled to handle about one million passengers daily, uses the Electro-Pneumatic brake. The Chesapeake and Ohio uses the type J equipment on a number of their fast passenger trains, while the Southern R. R. uses the High-Speed brake.

Leaving Slow Orders Out.

When important repairs are going on to the track of a bridge, a culvert or other weak spot, it is important that a slow order be displayed to prevent high train speed which might prove dangerous. Safety first is a good idea to go by under such circumstances. But safety first ought to be controlled by good sense. It may be the exception on some roads to leave the caution notices standing out infinitely after the repair work has been finished, but on one road that the writer is familiar with, the caution signals are habitually neglected after the danger they were intended to indicate has long passed.

After the track has been repaired the engineers come along and they are expected to respect the slow order day after day. It costs money to slow down any train, and the cost of forcing heavy trains back into speed adds considerably to the cost of train operating. A speaker at one of the Traveling Engineers' Conventions said: "I have known of bridge men coming along and making slight repairs to a trestle or small culvert and then put out a slow order which remained in force ninety days, and every train that passed in that time was slowed down."

The parties responsible for that species of waste ought to be disciplined. The real offenders are the superintendents in charge of divisions where such things happen.

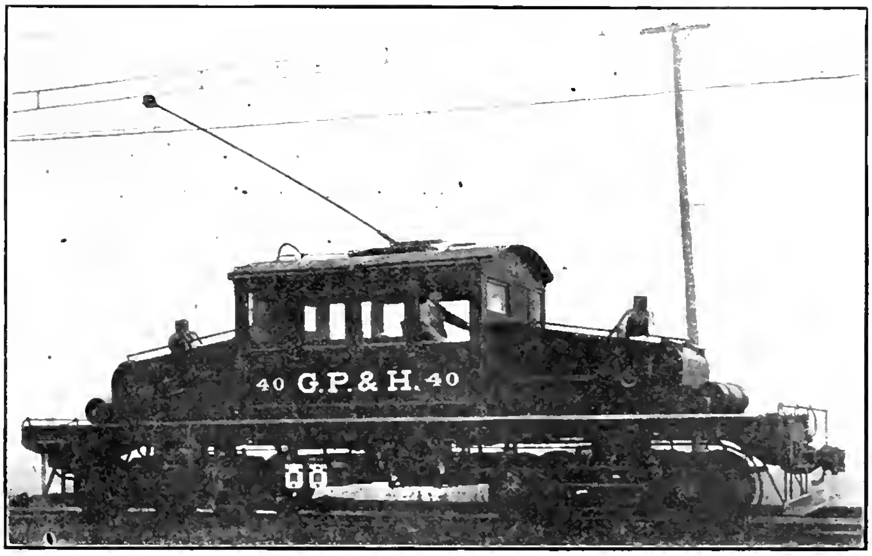
Two cubic feet of water falling six feet will produce one horse power of energy. Think of the immense energy falling over our numerous cataracts. The Mississippi River discharges into the Gulf of Mexico annually 18,400,000,000,000 cubic feet. That is the calculation but we can't follow it.

Electrical Department

Electric Locomotive Operating Notes.

THE GALT, PRESTON AND HESPLER RAILWAY CO., LTD., PRESTON, ONTARIO.

The Galt, Preston and Hespler Railway Co. placed the 40 ton Baldwin-Westinghouse Locomotive, herewith illustrated, in service on November 20, 1910, and since that date it has been in continuous operation, twenty four hours every day except Sundays, averaging about 150 hours per week. This service includes hauling practically every kind of freight in standard steam railroad rolling stock, between the Canadian Pacific Railroad, at Galt, and Waterloo, a distance of from 12 to 14 miles north.



GALT, PRESTON & HESPLER RY. 40-TON ELECTRIC LOCOMOTIVE.

Although the haul is not very long, there are a number of 2 to 2½ per cent. grades, from one to two miles long.

The maximum number of cars hauled in one train is about 25, the average number being 15, and the tonnage per train is about 200 tons.

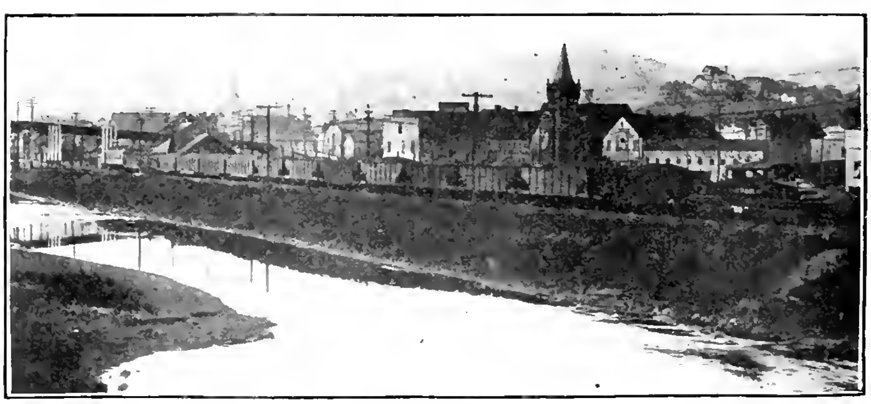
It is hardly possible to estimate exactly the total mileage, as the greater part of the time, 16 hours per day, the locomotive is in switching service.

This locomotive is equipped with four Westinghouse No. 308-B-2 commutating-pole, 600-volt, railway motors, rated at 120 h. p., and unit switch control.

Inspection and Maintenance. The locomotive is given one-half hour inspection every twenty-four hours, and about five or six every Sunday when making light repairs, such as applying brake shoes, changing wheels for tire running and inspection of motors, air-brakes, and control equipment. Tires have been turned twice since this locomotive went into service and the total repair account to date is given below:

Air Compressor (principally due to armature and field trouble due to low trolley voltage)	$170.00
Tire turning	45.00
Motor Axle Bearings	30.00
Unit Switch Control	50.00
Trolley Parts, Wheels, Harps, Poles and Bases	110.00
Brake Shoes	270.00
Miscellaneous	30.00
Total (from Nov. 30, 1910, to July 14, 1913)	$705.00

The total $705.00 for repairs on this locomotive covering a period of over 2½ years, is certainly a very good record. This example is only one of many and goes to show what a large amount of work can be obtained from an electric locomotive at a very low cost.


GALT, PRESTON & HESPLER RY LOCOMOTIVE HAULING A FREIGHT TRAIN.

The Application of the Electric Motor to Machine Tools.

We have mentioned from time to time, some specific case of the application of the electric motor, but have not treated the subject as a whole.

There are many advantages to be gained by motor drive in machine shops, a few of which are as follows:

Unobstructed light: In shops where machines are many and closely spaced, much of the light is cut off by the many belts. There is nothing so essential for the production of satisfactory and speedy machine tool work as plenty of light.

Absence of belts and belt troubles: A large number of belts require constant replacement or repairs. Moreover they have many drawbacks and many times are a source of trouble.

Increased head room for cranes, hoists, etc.: Eliminating the belting, it is an easy matter to place the machine tools in any desired locality, such as a gallery off from the main machine shop, or else under cranes or hoists where it would be practically impossible to place shafting.

Elasticity of arrangement: Having each machine driven by its own motor, no definite locality is necessary, and an elastic arrangement is secured. New tools can be easily added and tools moved or rearranged with a minimum amount of labor and time.

A close regulation of speed: With the variable speed electric motor, having a large number of speeds, over a wide variation, the particular speed most suitable for the work can be obtained. At the present time, where new tools require higher power and closer speed regulation, due to the use of high speed steel, it almost becomes necessary to use an electric motor direct connected to the tool.

Greater power and overload capacity: This advantage is perfectly obvious.

Flexibility for running only tools required: When working overtime, etc., it may be only necessary to use a small percentage of the tools, and with motor drive only those required need be operated.

Avoidance of line shaft troubles: This is self evident. We have reviewed some of the many advantages and it might be well to consider some of the questions and considerations that come up and which should be carefully studied and investigated before deciding on the final type of motor. Operating conditions vary greatly with the different kinds of work and while with some they are simple, with others they are more complex.

Due to the characteristics of the electric motor, it can be direct connected to the tool and the entire range of speed of the tool is within that of the motor.

In many shops it has been found advisable to place in the circuit of each tool, for a short period, a recording wattmeter, which tells the amount of power used, and also whether the tool is operating at its maximum rate. It serves as a tell tale to the tool, and conditions can be changed so that an increase in production will result.

Different operations require different types of motors. If the work is of a fairly steady nature, or when a considerable range of speed is required as on lathes, boring mills, etc., a shunt motor should be used.

Compound motors are used where a sudden increase of power is required, as on planers, presses, punches, etc.

Series motors are used where excessive starting power is required, as in moving heavy carriages, raising cross rails of planers, and operating cranes.

Another point to bear in mind when choosing motors is standardization. That is, as few parts or different types of motor should be chosen as possible so that under emergency conditions motors can be interchanged. A special motor may be desirable, but same should be chosen only after a very careful investigation to see whether this special feature overrules the adherence to a standard.

It is just as important to give careful attention to the choice of the control as it is to the motors. It should be arranged conveniently, so as to aid in the output. As an example, the operating handle on a lathe travels with the tool carriage so that complete control of the tool is obtained at all times. Another illustration is the case of a vertical milling machine on which two positions for the control are located, one on the floor line and one traveling with the cutters which may be several feet above the floor.

Practically all new machine tools are either fitted with a motor or else are adapted for one. However, machine shops have many older machines and it is with these that we are interested.

Many older machines have been fitted with the motor drive, and excellent service obtained. It is not a difficult matter.

The question of motor drive has reached such a point at the present time that the shop management can not afford to overlook it. The progress this form of drive has made warrants a careful study as to its merits.

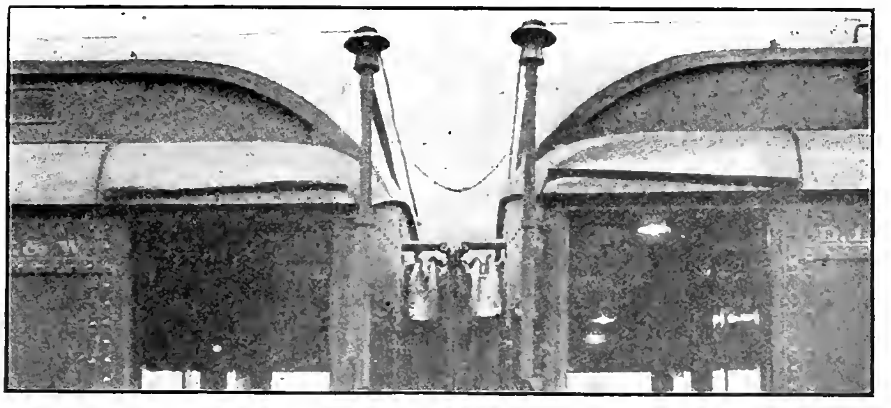
Wireless for Train Service

Wireless telegraphy has become so common that the wonderful things accomplished by means of it are overlooked. Its greatest application, of course, has been in connection with the ocean, to send messages between ships at sea, or between land and these ships. Now, however, it has taken its place for communication on land between a moving train and headquarters.

The Delaware, Lackawanna & Western Railroad is the first to carry out the experiments with "wireless." Prior to the making of the first test there had been a public clamor for better safety appliances, especially the automatic train stop, and the D., L. & W. R. R. knowing that tests on other roads with an automatic train stop were more or less discouraging, decided to try out the "wireless."

Two wireless towers were erected, one at Scranton, Pa., and one at Binghamton, N. Y., over sixty miles apart. Early in November of last year the first wireless train order was sent between these two stations. Having accomplished this step, it was thought advisable to go one further and fit a train with wireless so that messages could be sent directly to it. Many things presented themselves at once as possible objections to this arrangement. It is necessary for a wireless station to have a ground wire as is the case with the telegraph. Would it be possible to use the rails as the ground for the train? Would the use of the rails interfere with block signals? How much electric current would be required? Would it be possible to use current from the axle lighting system without interference with the lights?

These questions were all satisfactorily answered on the first trial trip on November 21, 1913, when messages were interchanged between the train and the stations at Scranton and Binghamton without interference with the block signals. The train, equipped with the apparatus, running between Buffalo and Hoboken regularly, has used the wireless many times to good advantage, for it is possible for the conductor to advise dispatcher of any emergency condition which may occur and arrangements can be made previous to the arrival of the train.



METHOD OF CARRYING THE AERIALS ON TOP OF THE CARS.

Sterilized by Electricity.

CITY OF LIVERPOOL SUPPLYING MILK TO 1,000 BABIES DAILY.

Milk sterilized by electricity, the microbes being killed by electric shocks, is being supplied from the Liverpool Corporation's milk depots to about 1,000 babies daily.

The new process was devised by Alderman Anthony Shelmerdine, Chairman of the local Infant Life Preservation Sub-Committee. One advantage claimed for the process over sterilization by steam is that the milk tastes the same as when it leaves the cow. Strict tests show that any tubercular or other contamination is removed.

A current of electricity of high voltage is passed through the milk. Dr. James M. Beattie, Professor of Bacteriology at Liverpool University, is closely watching the process.

During the last ten years, many thousands of infants have been fed from Liverpool's milk depots. The babies are visited by women inspectors, who report the results to headquarters and the data is being carefully tabulated, and steps have already been taken to introduce the purifying method into other large cities in England.

Mikado Type Locomotive for the Philadelphia & Reading

The Philadelphia and Reading Railway Company have always had in its mechanical department men of ingenuity and enterprise. They find means and time to experiment. In 1912 they built an unusually large Mikado type locomotive at the Reading shops. This engine had a boiler of the Wootten type, and was designed to use saturated steam. It proved highly satisfactory, and it has been followed by six more locomotives of similar type, which have been recently completed by The Baldwin Locomotive Works. The new engines are equipped with superheaters, and the details have been revised, where necessary, to better meet the requirements of the service; but the general dimensions are the same as those of the experimental locomotive.

In many respects the most interesting feature of the new design is the boiler, which is of the Wootten type, and of on each side, giving greater strength.

The boiler barrel is composed of three rings, the first measuring 84 inches in diameter and the third 96 inches. These are connected by a conical ring. This construction permits a satisfactory distribution of the tubes in the front tube sheet, together with a sufficiently deep water space under the combustion chamber. The dome is of pressed steel in one piece; it is 30 inches in diameter and 10½ inches in height. The superheater is unusually large, as it is composed of 48 elements and presents a superheating surface of 993 square feet.

The frames are of cast steel, each made in two sections, which are spliced back of the rear driving pedestals. The frame section, at the cylinder fit, measures 5 inches wide by 13 inches deep. The cylinders are cast separate from the saddle, and each cylinder is secured by 59 bolts, 10 of which pass through the frame. The latter is completely embraced by the cylinder and saddle castings, and the parts are keyed at the front. This forms an exceptionally strong construction. The steam pipes are outside, and they connect directly with the steam chests. A vacuum relief valve is tapped into each steam pipe. The joints between the cylinder and saddle castings are machined, and the exhaust enters the saddle through suitable openings which are placed above the frames. Both the steam and exhaust passages are free from abrupt bends. The steam distribution is controlled by 14-inch piston valves. The valve gear is of the Walschaerts type, and the Ragonnet power reverse mechanism is applied.

The rear truck, in this locomotive, is of the Hodges type, and it is equalized with the main and rear pairs of driving-wheels; while the first and second pairs are equalized with the leading truck. Particular attention has been given to the transverse frame bracing. Steel castings, bolted to the upper and lower frame rails, are placed midway between each of the adjacent pairs of pedestals.

The cab is placed at the rear end of the boiler, instead of ahead of the firebox, as has heretofore been the usual practice on anthracite burning locomotives built for this company. This construction has the advantage of keeping the men together.

The tender trucks are of the equalized pedestal type, with rolled steel wheels. The longitudinal frame sills consist of 12-inch channels, and the bumpers are of oak.

These locomotives exert a tractive force of 57,300 pounds, and in point of weight are the largest Mikado type engines thus far completed by the builders. Their unusually high steaming capacity fits them for the most severe duty. Further particulars are given in the accompanying list of dimensions:

MIKADO 2-8-2 TYPE LOCOMOTIVE FOR THE PHILADELPHIA & READING RAILWAY.

S. G. Thomson, Supt. Motive Power — Baldwin Locomotive Works, Builders.

rather unusual proportions. The fuel is a mixture of fine anthracite and bituminous coal, and this is burned on a grate measuring 12 feet long and 9 feet wide. The grate is of the rocking type, with bars having narrow openings to suit the fuel. There are two firedoors, each 13 by 18 inches, placed with their centers 30 inches apart transversely. The firebox has a shallow throat, with a combustion chamber 43 inches long, which extends forward into the boiler barrel. A brick wall is built across the rear of this chamber. The water space beneath it is 5 7/16 ins. in depth, and the crown is supported from three I-bars which are hung on sling stays. The sides and bottom of the combustion chamber, starting with the second row of stays above the center line of the boiler, are stayed with flexible bolts. These are also used in the upper corners of the throat, and in a large area

Gauge, 4 ft. 8½ ins.; cylinders, 24 ins. x 32 ins.; valves, 14 ins. piston.

Boiler—Material, steel; thickness of sheets, 7/8 ins. 15/16; working pressure, 225 lbs.; fuel, hard and soft coal mixed; staying, radial.

Fire Box—Material, steel; length, 144¼ ins.; width, 108¼ ins.; depth, front, 69 ins.; depth, back, 50½ ins.; thickness of sheets, sides, 3/8 in.; thickness of sheets, back, 3/8 in.; thickness of sheets, crown, 3/8 in.; thickness of sheets, tube, 5/8 in.

Water Space—Front, 5 ins.; sides, 4 ins.; back, 4 ins.

Tubes—Steel, No. 9, W. G. 48, diameter, 5½ ins. Iron, No. 11, W. G. 259, diameter, 2¼ ins. Length, 17 ft. 8 ins.

Heating Surface—Fire box, 245 sq. ft.;

combustion chamber, 81 sq. ft.; tubes, 3898 sq. ft.; total, 4224 sq. ft.; grate area, 108 sq. ft.

Driving Wheels — Diameter, outside, 61½ ins.; diameter, center, 54½ ins.; journals, main, 11 ins. x 13 ins.; journals, others, 11 ins. x 13 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 7 ins. x 11 ins.; diameter, back, 42¾ ins.; journals, 8 ins. x 14 ins.

Wheel Base—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total engine, 35 ft. 0 in.; total engine and tender, 68 ft 5½ ins.

Weight—On driving wheels, 240,600 lbs.; on truck, front, 26,800 lbs.; on truck, back, 55,900 lbs.; total engine, 329,300 lbs.; total engine and tender, about 485,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 36 ins.; journals, 5½ ins. x 10½ ins.; tank capacity, 8,000 gal.; fuel capacity, 12.8 tons; service, freight. Engine equipped with Schmidt superheater. Superheating surface, 993 sq. ft.

Rusting of Iron and Steel.

The most widely accepted theory of the cause of this rapid rusting or corrosion, called the electrolytic, is based on the fact that when two substances, having different electrical potentials, are immersed in a suitable electrolyte, an electric current is set up and corrosion begins at once. In iron or steel the various impurities differ from the element iron in their electrical potentiality, and the moisture in the air contributes the electrolyte. It is also true that this action is of a chemical nature, and that because of the very close connection between electrical and chemical action we are able to control this chemical action by stopping or accelerating the electrical action. Numerous investigators have been working for years along these lines and they have proven many facts heretofore in doubt to the great benefit of the iron and steel consumer. The purity of iron has a marked influence on the rapidity of corrosion, the quantity of the impurities must not only be very minute, but those few elements which it is impossible to remove entirely must be absolutely homogeneously distributed.

Iron is more sensitive and has the power of varying its crystallization or form of structure in a greater degree than any other metal, and the manufacturers have learned that the whole art of producing quality, corrosion resistant metal consists of freeing it of its impurities and producing the type of crystallization desired. Our constantly advancing knowledge of heat treatment and increased skill in the use of the pyrometer are making it possible to produce these quality products more and more uniform. Because of the extreme sensitivity of iron, great care must be used at its physical treatment, or the work of having eliminated the impurities will be labor lost. The strains produced in rolling, unless removed by careful annealing, will generate active corrosion. These strains are caused by excessive speed in rolling or by extreme pressure on the material in breaking down.

Some manufacturers have tried to offset their neglect to remove the objectionable impurities and their lack of careful physical treatment by the addition of copper.

This doped steel, instead of being benefited thereby, has to undergo an increase of the total impurities, and thus the opportunity for segregation of the latter is rendered easier, which two factors accellerate corrosion rather than retard it.

A Hard Boiler to Fill.

While talking about the peculiarities of locomotives and the mysterious disorders they are sometimes subject to, which make some unthinking people believe that the machines have moods of good and bad behavior, Mr. W. J. Hayes, superintendant of locomotive operation of the Erie, recently gave some edifying illustrations in a talk to a railroad club.

He said: "Years ago, when injectors were rarely found on locomotives, we were dreadfully hard up for power on the road I was employed upon in the Northwest, and it was necessary to keep engines in service when they were really unfit for work. The old 29 was a terror to the boys for some months, on account of the quantity of water she could get away with. When she was in the round house at night, one pump was kept disconnected, and it was the business of Joe Deitz and Sam Powers to keep water in the boiler by working the pump by hand, no light job. One night they were toiling very hard at the pump, and every few minutes the water gauge cocks were tried, but the water in the boiler kept dropping down, for the side sheets, crown sheets, flues and covers of the mud ring were all leaking.

Sam kept cussing the old engine and snarling at Joe for not making the pump jerk a little faster; but they both kept at it steadily enough, sweating and fuming till the water was out of the lower gauges, then they dumped the fire, and Joe was sent away to call the round house foreman and tell him that there would be no engine for train 3 in the morning. Foreman Brown got right out of bed, as many another man holding a similar position has had to do in the middle of the night, when scrap motive power has to be cared for. He looked the engine over and did not think that the leakage was sufficient to defy the pump. Then he made the pair of watchmen start up the pump again while he felt the check valve. There was no sign of water passing through, so he went to the engine tender and found it empty. The men had been toiling all night to pump water out of an empty tank.

Reduction of Oil Recommended.

A great many engineers act as if it were impossible to use too much oil on the working parts of a locomotive. They hold that there is constant danger from the working parts getting dry and cutting, through scarcity of lubricants, but that no harm can come from the supply being too liberal.

Some remarks made by Mr. J. F. Hawley, Inspecter of Locomotive Operation on the Erie Railroad at the last Traveling Engineers Convention throws a light upon the question. He said: "On the New York Division of that railroad we are using thirty-one Mikado locomotives with cylinders 28x32 inches. They are equipped with superheaters and brick arches. We were giving these locomotives three pints of valve oil for a distance of ninety-four miles straightaway. There was some trouble with carbonization in cylinders and valve chambers due to rings sticking, so we reduced the supply of oil to two and one-half pints and found that by so doing we eliminated a great deal of the trouble in regard to rings sticking. We use Perfection oil and are getting excellent results. On the same division we have several heavy passenger engines with cylinders 27x28 inches. We are allowing them two pints of Perfection oil and are getting good results."

Machinery Minders.

The people of the United States call the men engineers who run engines or have charge of machinery. The semi-scientific persons in Europe who hang like side weights upon engineering, call the real engineers by some other terms which enables the drawing room man the opportunity to boast that he is an engineer, although he very often can neither manage nor repair an engine.

We have noticed in an application sent from Glasgow, Scotland, that certain persons are termed stokers, engine minders, enginemen, engine drivers and engine oilers. In this country they would all be described as engineers.

In Case of Accident.

If an artery is cut, red blood spurts. Compress it above the wound. If a vein is cut, dark blood flows. Compress above and below the wound. For slight burns, dip the part in cold water; if the skin is destroyed, cover with varnish or linseed oil.

If the accident is serious, lose no time in sending for a doctor, but until he arrives, treat as directed above. That treatment may save life.

Items of Personal Interest

Mr. James H. Gaston has been appointed general foreman on the Georgia, with office at Augusta, Ga.

Mr. J. Delaney has been appointed master mechanic on the Great Northern, with office at Minot, N. D.

Mr. N. B. Ridlen has been appointed storekeeper on the Chicago & Alton, with office at Bloomington, Ill.

Mr. G. A. Gallagher has been appointed master mechanic on the Illinois Southern, with office at Sparta, Ill.

Mr. A. M. Nye has been appointed traveling engineer on the Colorado & Southern, with office at Pueblo, Colo.

Mr. A. Roesch has been appointed master mechanic on the Colorado & Southern, with office at Trinidad, Col.

Mr. C. A. Henkel has been appointed traveling engineer on the Denver & Rio Grande, at Grand Junction, Colo.

Mr. H. H. Gerback has been appointed car foreman on the Great Northern, with office at Great Falls, Mont.

Mr. A. Hume has been appointed traveling engineer on the Colorado & Southern, with office at Trinidad, Colo.

Mr. W. Apted has been appointed road foreman of engines on the Michigan Central, with office at Detroit, Mich.

Mr. H. I. Dorner has been appointed general car foreman of the Toledo Terminal, with office at Toledo, Ohio.

Mr. J. A. Tschuon has been appointed master mechanic on the Baltimore & Ohio, with office at Washington, Ind.

Mr. J. L. Boyle has been appointed road foreman of equipment on the Rock Island, with office at Goodland, Kans.

Mr. R. Dennis has been appointed general foreman of the Toledo and Ohio Central, with office at Toledo, Ohio.

Mr. J. Q. Myers has been appointed locomotive foreman on the Great Northern, with office at Grand Forks, N. D.

Mr. John Bauer has been appointed master mechanic of the Alton, Jacksonville & Peoria, with office at Alton, Ill.

Mr. W. Wade has been appointed foreman of shops on the Chicago & Northwestern, with office at Janesville, Wis.

Mr. R. Mennie has been appointed inspector of tools and machinery on the Rock Island, with office at Chicago, Ill.

Mr. C. F. Gregory has been appointed master mechanic on the St. Louis & O'Fallon, with office at St. Louis, Mo.

Mr. F. F. Gaffney has been appointed division foreman on the Colorado & Southern, with office at Cheyenne, Wyo.

Mr. W. A. Hall has been appointed master mechanic on the International & Great Northern, with office at Mart, Tex.

Mr. H. C. Rowley has been appointed general foreman at the Zanesville and Western, with office at Fultonham, Ohio.

Mr. J. W. Mahon has been appointed master mechanic on the Kanawha & West Virginia, with office at Charleston, W. Va.

Mr. H. P. Roby has been appointed traveling engineer on the Bangor & Aroostook, with office at Milo Junction, Me.

Mr. M. L. Goehringer has been appointed signal supervisor on the Missouri Pacific system, with office at Nevada, Mo.

Mr. George Shimming has been appointed foreman of shops on the Chicago & Northwestern, with office at Madison, Wis.

Mr. H. P. Forsberg has been appointed foreman of shops on the Chicago & Northwestern, with office at Superior, Neb.

Mr. L. Woster has been appointed master mechanic on the Cincinnati, Hamilton & Dayton, with office at Ivoryville, Ohio.

Mr. B. Ferrie has been appointed acting general foreman on the Detroit, Toledo & Ironton, with office at Delray, Mich.

Mr. W. R. Elmore has been appointed general foreman on the Denver & Rio Grande, with office at Salt Lake City, Utah.

Mr. W. H. Davis has been appointed road foreman of engines on the Chicago & Alton, with headquarters at Bloomington, Ill.

Mr. W. H. Hoffman has been appointed division master mechanic on the Chicago & Northwestern, with office at Green Bay, Wis.

Mr. J. J. Pendergast has been appointed master mechanic of the Colorado, Kansas & Oklahoma, with office at Scott City, Kans.

Mr. J. F. Dunn has been appointed superintendent of motive power on the Oregon Short Line, with offices at Salt Lake City, Utah.

Mr. C. M. Hoffman has been appointed master mechanic of the San Pedro, Los Angeles and Salt Lake, with office at Milford, Utah.

Mr. Albin Ulrich has been appointed general foreman of electric construction on the Boston & Maine, with office at Boston, Mass.

Mr. Edward Drury has been appointed general foreman of bridges and buildings on the Santa Fe, with headquarters at Newton, Kans.

Mr. E. J. Garrett has been appointed road foreman of equipment on the Missouri & North Arkansas, with office at Harrison, Ark.

Mr. Frank D. Waller, formerly secretary of the Flower Waste & Packing Company, New York, has become the owner of that company.

Mr. E. E. Worthing has been appointed signal supervisor on the Galveston, Harrisburg & San Antonio, with office at Houston, Tex.

Mr. T. H. Richardson has been appointed general foreman of mechanical construction on the Boston & Maine, with office at Boston, Mass.

Mr. R. E. French has been appointed superintendent of motive power and engineer on the Gulf, Texas & Western, with offices at Jermyn, Tex.

Mr. L. F. Hamilton has been appointed district master mechanic of the Ontario division of the Canadian Pacific, with office at West Toronto, Ont.

Mr. P. J. Flynn has been appointed general superintendent of motive power on the Delaware, Lackawanna & Western, with offices at Syracuse, N. Y.

The Jerome-Edwards Metallic Packing Company has placed its railway sales in the hands of the Equipment Improvement Company, 30 Church street, New York.

Mr. Karl A. Heine has joined the Sales Department of the Chicago Car Heating Company, with offices at Grand Central Terminal Building, New York City.

Mr. E. W. Sandwich has been appointed superintendent of car service on the Atlanta & West Point and Western Railway of Alabama, with headquarters at Montgomery, Ala.

Mr. F. O. Walsh has been appointed superintendent of motive power of the Georgia Railroad with headquarters at Augusta, Ga., in place of Mr. J. W. Walters, resigned.

Mr. F. Nicholson has been appointed master mechanic of the Louisiana Railway & Navigation Company, with headquarters at Shreveport, La., in place of Mr. M. F. McCarra, resigned.

Mr. A. C. Adams, who recently resigned as superintendent of motive power of the Spokane, Portland & Seattle, has been made the Pacific coast general agent of the General Brake Shoe & Supply Company, Chicago, at Portland, Ore.

Mr. J. A. Wilkins, formerly roundhouse foreman on the Southern at Selma, Ala., has been transferred to a similar position on the same road, at Birming-

ham, Ala., and Mr. G. W. Thomas has been appointed to succeed Mr. Wilkins at Selma.

Mr. W. J. Lloyd has been appointed master mechanic on the Oregon Short Line, with office at Pocatello, Idaho, and Mr. D. J. Malone has been appointed to a similar position on the same road, with office at Salt Lake City, Utah.

Charles A. Carscadin has been elected president of the National Car Equipment Co., with offices in the Railway Exchange building, Chicago. George A. Woodman, formerly of the Kirby Equipment Co., is general manager of the company.

Mr. Scott R. Hayes has been appointed assistant to the president of the New York Air Brake Co. Mr. Hayes has been with the Railway Steel-Spring Co., New York, since its organization, and resigns to go to the New York Air Brake Co.

Mr. C. G. Hartman, formerly with the Chicago, Milwaukee and St. Paul, at the Milwaukee shops, has been appointed mechanical foreman on the Wisconsin and Michigan, with headquarters at Peshtigo, Wis. Mr. Hartman assumes the duties of Mr. C. H. Stroud, formerly master mechanic, resigned.

Mr. Luther Rukel has been appointed road foreman of engines on the Wabash, with office at Moberly, Mo., and Mr. A. F. King has been appointed to a similar position on the same road, with office at Peru, Ind., and Mr. W. G. Cooper has been appointed to a similar position on the same road, with office at St. Thomas, Ont.

Mr. John Dickson has been appointed master mechanic of the Spokane, Portland & Seattle Railway, Oregon Trunk Railway, Oregon Electric Railway and United Railways, with headquarters at Portland, Ore. The office of superintendent of motive power, which A. C. Adams recently resigned to engage in other business, has been abolished.

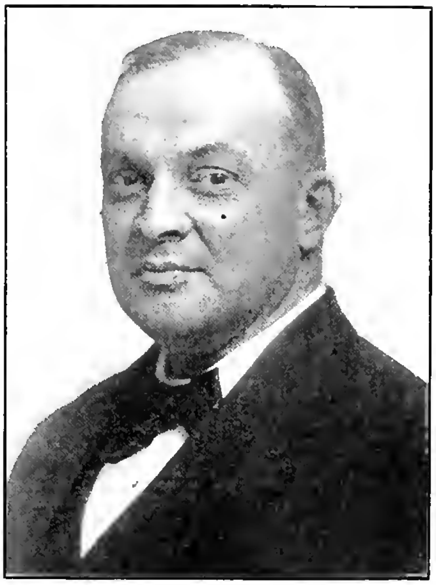
Mr. B. S. McClellen, in charge of the railway sales department of the McCord Manufacturing Company, Chicago, has resigned in order to give more personal attention to his other interests. The McClellen Nut Company, Chicago, which he has just organized, will shortly place upon the market a one-piece self-locking nut, which will be known as the "Unit" lock nut.

Mr. A. L. Patterson has been appointed superintendent of motive power of the San Antonio, Uvalde and Gulf, with office at Pleasanton, Tex., and Mr. H. M. Warden has been appointed general foreman of the locomotive department, and Mr. W. H. Pinson has been appointed general foreman of the car department, both on the same road, with offices at Pleasanton.

Mr. C. McDermott has been appointed chief electrician on the Pere Marquette, with office at Grand Rapids, Mich., and Mr. Charles Boertman has been appointed shop superintendent on the same road, with office at Saginaw, Mich., and Mr. A. Barrow has been appointed assistant road foreman of engines on the same road, at Grand Rapids, Mich., and Mr. J. E. Wilson and Mr. T. E. Wolfe have been appointed road foremen of engines on the same road, also at Grand Rapids.

The Board of Directors of the Erie Railroad have elected Mr. D. W. Cooke vice-president and general traffic manager. Mr. Cooke is a Western man, having first entered railway service on the Chicago & Northwestern. In 1895 he became assistant passenger agent of the Erie, and since that time he has advanced steadily. The secret of his success seems to have been natural energy, business capacity and vigorous devotion to business.

Mr. W. H. Dressel has been appointed master mechanic on the Oregon, Washington Railroad & Navigation Co., with office at Portland, Ore., and Mr. George Ross has been appointed to a similar position on the same road, with office at La Grande, Ore., and Mr. T. H. Yorke has been appointed to a similar position on the same road, with office at Spokane, Ore., and Mr. A. M. Brown has been appointed scale inspector on the same road, with headquarters at Portland, Ore.



WILLIAM COOPER.

Mr. A. E. Schafer, who has been general sales manager of the Sherwin-Williams Company, has accepted a position with the Flint Varnish Works, Flint, Mich. He will assist President W. W. Mountain in the management, and will have full charge of the railroad department. Mr. Schafer was with the Sherwin-Williams Company for 28 years, the last six years as general sales manager.

The Railway Business Association will have the following officers for the coming year: President, Geo. A. Post, New York; treasurer, Chas. A. Moore, New York; assistant treasurer, M. S. Clayton, New York; vice-presidents, A. M. Kittridge, Dayton, O.; W. E. Clow, Chicago; G. W. Simmonds, St. Louis; S. P. Bush, Columbus, O.; Alba B. Johnson, Philadelphia; H. G. Prout, Pittsburgh; W. G. Pearce, New York.

The Chicago Car Heating Company has recently opened a branch office and factory at 61 Dalhousie street, Montreal, Canada, to take care of its rapidly increasing business in the Dominion. Mr. A. D. Bruce, formerly purchasing agent of the company at Chicago, is in charge. Mr. Bruce is a native of Guelph, Ontario, but has been connected with the Chicago Car Heating Company in Chicago for the past five years. Mr. Karl A. Heine has joined the sales department of this firm, with offices in Grand Central Terminal building, New York City.

Obituary.

WILLIAM COOPER.

Mr. William Cooper, Director of Buildings and Equipment of the East Pittsburgh works of the Westinghouse Electric and Manufacturing Company, died from peritonitis at his home in Wilkinsburg, Pa., on the 23rd of last month. Mr. Cooper was in his fifty-third year. He was a graduate of Cornell University. Mr. Cooper was a mechanical engineer, of marked ability, and wide experience, and entered the employ of the General Electric Company at Schenectady in 1894, and his services were of great value in the revolution of the design of railway motors. He superintended the construction of the electric locomotives for the Baltimore and Ohio tunnel at Baltimore, and put them in service. In 1904 he entered the employ of the Westinghouse Company. This work developed the type of electric control now being used by the Company. He was also largely instrumental in designing the electric locomotives in use on the New York, New Haven and Hartford. He was universally loved and respected by all who had the honor of his intimate acquaintance, and his death is very much regretted.

WILLIAM H. BOARDMAN.

The death is announced of Mr. William H. Boardman, at Ridgefield, Conn., on the 16th of last month, in the sixty-seventh year of his age. Mr. Boardman was born in Illinois, and at an early age became connected with the *Railroad Gazette*, which afterwards united with the *Railway Age*, and became known as the *Railway Age Gazette*. Mr. Boardman, besides being editor of the paper referred to, contributed to other periodicals. He was an ardent lover of out-door life, and became President of several Social Clubs and Societies.

A Triumph in Blacksmithing

It is always a pleasure to note that among workmen engaged in mechanical employment there are many gifted with the artistic temperament and who when opportunity occurs give to their work the impress of their individuality. In this material age, when commercialism has run mad and scientific management is making frantic efforts to take the last ounce of vitality out of the weary hands of the overworked toiler, it is, as we have said, a real source of pride and satisfaction to note that greed and speed cannot altogether stifle the aspirations of the born artist, and as the flower springs out of the grosser elements of the earth, so will the hand of a master mechanician show its cunning, in spite of the incessant and heavy blows of circumstance.

These prefatory observations are called forth when we contemplate the work of Mr. James Cran, foreman blacksmith of the Pond Machine Tool Works, Plainfield, N. J. All day he is engaged in superintending the most intricate and exact work in forging the fine products of that manufacturing company. In his leisure hours, which are few, he has a small forge in the rear of his fine home, and out of the same materials of which the fine tools are made, Mr. Cran, with his hammer and tongs and flaming forge, molds into everlasting beauty wreaths of flowers that defy the winter's frost. Roses bloom into full blossomed splendor and lilies hang their graceful heads, and daisies open their starry eyes and asters rise into clustered beauty under his cunning hand. Not only the flowers of the field are there, but the wealth of grapes and wild berries adorn the little smithy shop in perennial richness. Nature in her beauty and solitude is outrivalled there, because her efflorescene has become imperishable.

Not only so, but the sculptor in iron is not confined to floral decorations. His creative hand revels in decorative art. Lamps and lanterns and shields and tablets take on a new beauty, and iron is like clay in his hands. He has worked quietly at his high art for several years, the joy of fashioning the fine work being its own highest and best reward, but he can no more keep himself hid than a tree can that has become glorified under the fiery finger of September while the other trees are still green. Work of the highest and best kind is coming to him, but his sense of duty keeps him at the tool shop, and while he has already done much admirable special work, his real reward, as we have already stated, is his love of art for art's sake.

Mr. Cran began his industrial and artistic career in America twelve years ago with A. G. Spalding, of New York, as blacksmith, at his factory at Chicopee Falls, Mass. Next he went to Hartford, with the Electric Vehicle Company, then, after a trip through the United States and Mexico, he settled in

ROSE WREATH OF SWEDISH IRON.

Plainfield about six years ago. While working his way across America he stopped for a time in Manhattan, Kansas, and was engaged for some time as instructor of iron work in the State College. He might have remained there and settled down as a member of the

JAMES CRAN, ART SMITH.

accomplished faculty. But he was not praying for an easy life, he was looking for more strength, and it has come to him. He went into all kinds of blacksmith shops looking for information, and quietly acquiring that degree of skill and that mass of information that rarely comes to the homekeeping artisan. Like the painter that goes to Paris or the musician that lingers in Munich, Mr. Cran may be said to have taken to the wayside smithy, where there are no tools to speak of but where there is often a degree of ingenuity that would surprise the seeker after truth.

Mr. Cran was not dreaming of sculpture work during his wanderings. He was looking for information, and was ambitious to acquire skill, and he went the right way about it. He got what he was looking for, and his attention to metallic floriculture came about in this way:—A New York periodical published an article describing the work of Louis Van Boeckel, a Belgian blacksmith, and incidentally illustrated the article with a reproduction of a rose wreath made by Boeckel. Cran's imagination took fire. The bellows of his ambition blew hard. Would the editor send him a sample of Boeckel's work? Surely. A sprig of roses was sent to Plainfield, and Cran lighted his pipe and then his fire, and he took an old chain of Swedish iron and welded it into a solid lump and drew it out under the steam hammer into bars, and then began in earnest. Next month the editor admitted that Cran's work was better than Boeckel's. In particular the actual blacksmithing, as apart from the art feature, was better. The welds were cleaner and neater, and Cran had unquestionably gone closer to nature to get his model. And this first attempt, which was the production of a rose wreath excelling Boeckel's, was done on an ordinary anvil with common tools.

It is pleasant to be able to reproduce a small illustration of this triumph of blacksmithing, and also a portrait of the man himself. The wreath is 13 inches high. It is made of 94 separate pieces and occupied about 13 hours in making. The smith himself is a tall, athletic, dark haired man with a grip like a new vise and a face that lightens up and becomes luminous with intelligence as he unfolds the mysteries of his rare work. He has no trade secrets. His work is as open as the day is when the clouds are vanished. Any other smith may do the same work if he can.

Louis Van Boeckel.

The celebrated Belgian blacksmith, Mr. Louis Van Boeckel, although well advanced in years, is still working wonders at the anvil in the village of Lier, about eleven miles from Antwerp. He is very much admired by his countrymen, and much of his fine work is in the possession of the nobility in Belgium. He has been awarded numerous diplomas and medals at European exhibitions. At the Liege Exhibition in 1905 he was awarded the *Grand Prix*. The forging consisted of an eagle and a fanciful monster in conflict.

American Railroad Official Appointed General Manager of British Railway.

Railway circles on two continents were very much excited last month by the announcement that Henry Worth Thornton, general superintendent of the Long Island Railroad, had been chosen to be general manager of the Great Eastern Railway of England. In making the selection Lord Claud Hamilton, chairman of the Board of Directors of the Great Eastern Railway, explained that he could not find a railway official in Great Britain to fulfill the requirements as operation head of the Great Eastern, and his views have created a furore of protest in the British Isles. Lord Claud Hamilton made some reflection upon the method of training British railway officers which has a narrowing tendency and that has been resented.

In the appointment Mr. Thornton is spoken of as general superintendent of

HENRY WORTH THORNTON.

the Long Island Railroad, which hardly does justice to the man's training. He may better be called a graduate of the Pennsylvania Railroad system which has given many eminent railroad officials the experience that carried them to the head of the profession. Born in 1871, he was educated in the University of Pennsylvania and entered railroad service in 1894 as draftsman on the Pennsylvania Lines West of Pittsburgh, a position he held for four years, after which he held positions as assistant engineer till 1902, when he was appointed superintendent Marietta division of the Northwest system. Then he became superintendent of Erie & Ashtabula division of the Northwest system. There he remained until 1911, when he was appointed general superintendent of the Long Island Railroad, which is one of the proprietory lines of the Pennsylvania Railroad Company.

Mr. Thornton has made good in every position filled, and he was regarded as one of the most efficient and promising officials on the Pennsylvania Railroad system.

Frank Hedley.

Mr. Frank Hedley, who has recently been elected president of the New York Electric Railway Association, is vice-president and general manager of the Interborough Rapid Transit Co., of New York city. He was born at Maidstone, Kent, England, in 1864 and came to this country when 18 years old. For several years he was engaged as a machinist in the Jersey City shops of the Erie Railroad and then in the shops of the New York Central Railroad. He then entered the employ of the Manhattan Elevated Railway, of New York city, as a machinist, and in 1885 became assistant general foreman in the locomotive department. In 1889 he was appointed master mechanic of the Kings County Elevated Railroad, Brooklyn, and in 1893 resigned to become general superintendent of motive power and rolling stock for the Lake Street Elevated Railroad, of Chicago. A few months later he was appointed general superintendent of the latter company. Shortly after this he was appointed consulting engineer by the late Charles T. Yerkes, in addition to his other duties. He retained this position throughout the construction of the Northwestern Elevated and Chicago Union Loop. Upon the completion of these properties he was appointed general superintendent in charge of operation. In January, 1903, he was appointed general superintendent of the Interborough Rapid Transit Company, of New York, and the following year general manager. On July 1, 1908, he was elected vice-president and general manager of the company. Mr. Hedley is also vice-president and general manager of the New York Railways Company, vice-president of the Subway Construction Company and manager for the trustees of the New York & Long Island Railroad.

Westinghouse Veterans.

The employees of the Westinghouse Electric & Manufacturing Co., who have been in its employ over twenty years, organized a Veteran Employees Association last month. Of the 325 employees eligible to membership 315 were present. By-laws were adopted and officers elected. Speeches were made by President Mr. F. M. Herr, Vice-President Mr. Chas. A. Terry, and Mr. Jas. J. Barrett, who represented the shops. Mr. Herr stated that plans were being made to pension the employees, the details of which will be announced at an early date. The meeting was followed by a dinner, Mr. L. A. Osborne, vice-president of the Electric Company acting as toastmaster. Mr. Guy K. Tripp, Chairman of the Board of Directors, was present. Eloquent tributes were paid to Mr. George Westinghouse.

The Cost of Railroads for Alaska.

The Seward-Fairbanks road proposed by the Commission appointed to report upon conditions in Alaska would cost approximately 18 million dollars, and the Kuskokwim Branch as much more. The tional. These lines, and the Copper River reached for a million and a half additional, These lines, and the Copper River road to Fairbanks, with its Bering River branch, could all be built for 60 million dollars. That is approximately the cost of making over Alaska.

The people of Alaska have a vision of the valleys of their interior territory dotted with towns of permanent industry where men make their homes and rear their families, towns with smelters, machine shops, stores, churches, and schools built of the timber from the surrounding hills and fed with the produce of adjacent farms. This does not mean settlement like a German landscape, but settle-

FRANK HEDLEY.

ment such as there is now in Colorado. Between this vision and realization looms the great Alaskan mountain range and the cost per ton mile of freight.

It is a territory eager to be loosed from the restrictions which the long controversy has placed upon it. It wants the chance to mine and farm and trade and to grow rich with the keen enthusiasm that has characterized the Western frontier. —*The World's Work.*

Virtue of Industry.

Charles Kingsley is known as a writer of stories, many of them embracing sound moral principles. He says: "Be glad every morning when you get up, that you have something to do that day which must be done, whether you like it or not. Being forced to work and forced to do your best will build in you temperance and self-control, diligence and strength of will, cheerfulness and content, besides a hundred virtues which the idle never knows."

Compliments Paid to Us.

At one of the Traveling Engineers Conventions, a very high compliment was paid to RAILWAY AND LOCOMOTIVE ENGINEERING as an educational medium. The subject under discussion was the training of firemen, and Mr. W. R. Scott, who is now general manager of the Southern Pacific, said: "In my traveling about the road, I have had a great deal of missionary work to perform from time to time, and the assistance I found most valuable was from the publication known as LOCOMOTIVE ENGINEERING. I took quite an active interest in obtaining subscribers for that paper, and I found that the average man is more apt to read and reflect on what he reads when it is furnished him in small doses. I find that since they have been reading that paper, as a rule they have some question or some remarks or comments on some particular thing they have seen in the paper and they are always anxious to get next month's paper. I believe that a publication of that kind is indispensable to every locomotive engineer and fireman ambitious to keep well posted about his business. I know that it has helped me a great deal and I have always advocated it to the men."

Mr. D. R. McBain said: "my experience has been the same as Mr. Scott's. I find that such papers as LOCOMOTIVE ENGINEERING have done more to educate the train men, including engineers and firemen in a technical way than any other literature they can find."

Mr Conger said: "I can reach the men by writing an article in some of the railway papers, when I can't touch them in the round house or on the engine. When they get their LOCOMOTIVE ENGINEERING and get their feet up after supper and read it, they believe every word. I believe in encouraging enginemen to read such such papers as LOCOMOTIVE ENGINEERING. It pays the company as well as the men."

Imaginary Troubles.

Some people of a nervous temperament imagine that magnets affect their nerves, but it is entirely imaginary. That is, they will go almost distracted when they are aware that they are within the influence of a magnet. An eminent Italian physician was consulted about a man who seemed to be intensely susceptible to magnetic influence. The physician carried a piece of common iron, formed into the shape of a horse shoe magnet, into the patient's room, and he immediately went into convulsions. A short time afterward the magnet dreading patient agreed to preside at a scientific meeting and the aforementioned physician secretely introduced beforehand, very powerful magnets into the chair where the presiding officer would sit. The meeting lasted two hours and the man who fainted at the sight of what he thought to be a horse shoe magnet, displayed no discomfort at sitting in a strong magnetic field.

We think this species of self deception is by no means novel and its effects have been often demonstrated in the reception given by different men to new railway appliances. We recently heard two intelligent master mechanics describing their experiences with a certain scale preventative for boilers. The feed water in both cases was practically the same, but one found the scale remedy utterly useless, while the other said it was a perfect remedy. The same kind of contradictory testimony may be found about every improvement introduced for locomotive use.

Iron and Steel Processes.

It is to Tubal Cain that we owe the incentive which has resulted in the development of iron and steel to its present condition. It was he who started mankind on a new quest, the quest of the use of iron, and consequently we have the multitudinous products which are made from iron and steel and upon which we place so much dependence. The sons of Tubal Cain have been striving to the utmost to increase the use of steel and iron, better its quality and increase the quantity, in order that we may have at our disposal, not only the best but a plentiful supply of it. It is undoubtedly true that at the present time more men are engaged in this industry and its allied arts than in any other single industry of the country, and after all these years of careful research and investigation the art is still in its infancy, and there are many problems which yet remain to be worked out. The progress in the art of manufacturing iron and steel has been most remarkable in the last years, and of all the factors which have contributed towards it, none have been more influential than the destructive forces of corrosion, which have challenged the best efforts of man to produce a permanent iron or steel product, and it is a well-established fact that the processes of manufacture have much more to do with the final lasting quality of the material than was formerly supposed.

Useless Knowledge.

We all know what a low opinion the late President Crane held on college education for business men. Other eminent men share Mr. Crane's views on that subject.

A writer in a leading British magazine says: "Greek is useless but its uselessness is the very strongest reason for its being a compulsory subject in the university course. For the true function of a university education consists of useless knowledge uselessly taught."

Council of War.

Archie was playing Indian with his little comrades, who were all arrayed in more or less aboriginal costume, and apparently having a fine time yelling and racing about the back yard. A council of war was decided upon, and things quieted down for a while. After some time Archie entered the house, looking rather pale and weak, and without a word threw himself upon the couch. Mother happened to pass through the room, and, glancing towards the couch, saw Archie, rather doubled up, and looking far from contented. "Why, my child," she exclaimed, "how you look! You are as white as chalk! You boys have been hitting one another all to pieces again!" "No, we haven't, mother," returned Archie in a whisper. "Well, do tell me what is the matter with you then." "Oh, we just had a council of war, and we had to smoke the pipe of peace."

Quite a Stranger.

There was "standing room only" in the subway car, and the two young women peered in vain for a seat. "Just watch me get one," the prettier of the two whispered. She approached a "tired business man," whose nose was in his paper. "Why, Mr. Smith, how do you do? You're quite a stranger. Will I accept your seat? Oh, thank you so much." With a malicious smile the man arose and doffed his hat. "Sit down, Nora, my girl," he said. "Have you been ill? I hear you didn't call for our wash this week!" And "Nora" crimsoned while the car tittered.

Found Three of Them.

Three dudes were walking along the street one day and met an old, decrepit minister, with whom they expected to have fun. The first dude called out, "Hello, Father Abraham." The second said, "Hello, Father Isaac," and the third exclaimed, "Hello, Father Jacob." The minister was familiar with the application of Scripture texts and replied: "I am neither Abraham, Isaac nor Jacob; but Saul, the son of Kish, looking for his father's asses and behold I have found three of them."

Fear of Competition.

Among the people who build machine tools and special mechanical appliances there has long been nervousness displayed for fear rivals might find out something from the designs put upon the market. Those who are afraid that competitors will find out something should reflect on Kipling's lines:

"They copied all I could follow,
 But they couldn't copy my mind;
And I left 'em swearing and stealing
 A year and a half behind."

A Gossip Hit.

During the latter years of his life the well known editor, Mathias N. Forney, was very much troubled with visitors who would indulge in senseless gossip without realizing the value of their host's time. One day an inveterate offender was stealing Mr. Forney's time and he asked: "What do you do when people come in and bore you?"

"When they stay too long, the office boy, who is very bright, and knows just when to interfere, tells me that a gentleman is in the counting-house waiting to see me on important business."

"Ha! ha! That's a capital way to get rid of bores who don't know——" Just then the boy opened the door, sang out:—"Gent in the countin'-house, sir, waitin' to see you on important business!"

North and South Handed.

As regards the moral significance of the right and left hands a Highland friend, who is something of a Gaelic scholar, gives (says a writer) the interesting information that in Gaelic the right and left hands become respectively the "south" hand and the "north" hand. The moral aspect of it comes out in the Gaelic idea of the south as rich, well favored and fortunate, and the north as the reverse. In the "south" hand are carried riches and honor. The north-handed man is unlucky. And now we know why it is so many Scotsmen go southward!

The Fire Escape.

They were country people, pure and simple, but they had read the home papers and thought they were educated up to all the improvements of the day.

When they visited Washington, D. C., they went through the Navy Department and saw the models of some of the new battleships.

Pointing to a companion ladder hanging over the side of one of the ships, she asked her better half what it was.

"Oh," he replied, "that's the fire escape."

A Quick Passage.

An old Pennsylvania German living in the mountains had a hard three hours' dusty walk to accomplish one morning and he rose very early to make his start. He had gone but a little way when he was overtaken by an automobile, which was probably the first that had passed along that way. The driver picked up the old man and they were at his destination in about twenty minutes.

"Danks so much awfully mit de ride. If I had known myself to be here already two hours in front of de clock I vud be at home fast asleep already to start unless I knew you vud not have picked me up since."

Ancient High Civilization.

In the history of the world, a dense period of darkness blotted out remembrance of what had been achieved in the earlier civilization and much of modern progress made, is reinventing devices and processes that were familiar to people very long ago.

The Assyrian empire, which was formed about 1250 B. C., was celebrated for what we would call industrial achievements, at a time when war was the pastime of other nations. Architecture was their chief glory and their sculpture displays a wonderful grandeur, dignity, boldness and strength.

In the useful and mechanical arts, they had reached great skill. They not only had transparent glass, but even lenses; they were well acquainted with the principle of the arch and used it in the construction of aqueducts and tunnels. They knew the use of the pulley, the lever and the roller; they understood the arts of enameling, inlaying and overlaying with metals; they cut gems with the greatest skill and finish, and in the ordinary arts of life, they were nearly on a par with modern practices.

Discipline.

Various incidents of railway operating of late years have raised the question, "Does discipline of railway train men make them more efficient?" Years ago, when Charles Francis Adams wrote his book on railroad accidents, he maintained that the American locomotive engineer could be depended upon to bring his train over the road safely under circumstances that would mean disaster in other countries. And these men were subjected to the least possible discipline. The American engineer had practically the help of no signals and had to depend upon his own judgment and vigilance. Since Adams wrote nearly all railroads have introduced elaborate signal systems, with detailed rules of operating, yet train accidents have become more numerous.

Among the train men of every railroad, there are a certain number of men who are inefficient and always meeting with mishaps. A strict system of discipline weeds these men out which is an advantage to themselves and to all other men likely to suffer from the mistakes of blunderers. We certainly think that train men are not suffering from too much discipline.

The State of Louisiana has eleven legal holidays each year, the highest number of any state in the Union. It is expected that when labor unions become more powerful in the state, that a few of the legal holidays will be cut out.

Heat.

What is heat? Heat is a mode of motion. That is, it is an immaterial force resulting from vibrations of the molecules or atoms of matter. The more rapid the vibrations the greater the heat.

What are the Principal Sources of Heat? The sun is the greatest source of heat on the earth. All the coal, the oil and the vegetable matter used for heating purposes were originally vitalized by the sun's rays. The earth's surface receives some heat from the interior of the globe which is no doubt a molten mass. Hot springs and the lava thrown up by volcanoes seem to prove this. Other sources of heat are chemical action, mechanical action and electricity.

What is the Dynamic Theory of Heat? An old theory respecting heat made it out to be a subtle substance residing between the atoms of bodies. The effects of friction and impact in creating heat, convinced scientific men that heat was the rapid vibrations of the molecules in ordinary matter.

In what way does heat diffuse itself? 1. By Conduction when the molecular vibrations are transmitted directly from one molecule to another, as in the case of a poker getting hot outside the fire. 2. Connection diffuses heat by putting the molecules into energetic vibration vibration, as in the boiling of a caldron set upon a fire. 3. Radiation, as when the warm rays of a furnace fire throw heat upon the heating surface.

What is the Thermal Capacity of a body? The ratio of the heat required to raise the temperature of one pound of water one degree at its greatest density, 69 degrees Fahr.

Completion of Mount Royal Tunnel.

After over a year of tunneling through 3.1/10 miles of rock, the railroad tunnel under Mt. Royal, Montreal, was completed. This establishes a record for tunnel building through such material in America. The work was done by the Canadian Northern Railway Company. The excavation of Swiss tunnels has been done in less time, but generally the rock encountered was not so hard as that at Mt. Royal. The present inside measurements of the tunnel are 8 x 12 feet. When the work is completed it will be enlarged to 22 x 30 feet to accommodate two tracks.

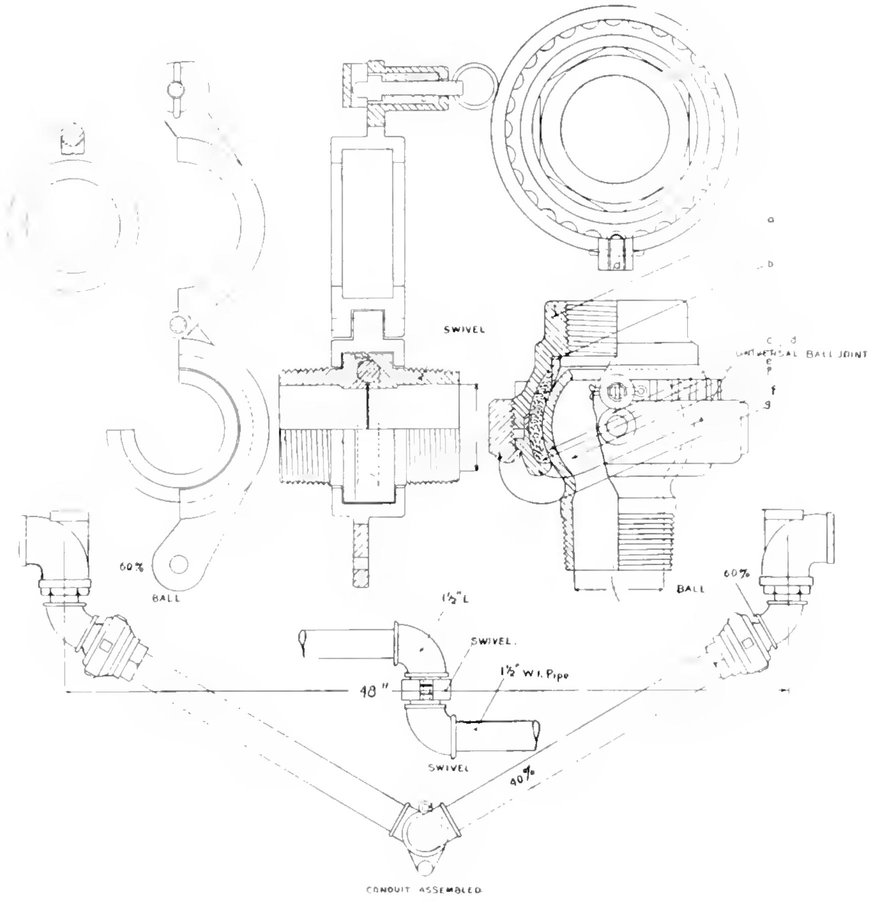
The United States Light & Heating Company has changed the location of its New York City branch sales office from 30 Church street to 210 West Fiftieth street, bringing the New York service station and sales office into the same building. The general offices of the company remain at 30 Church street.

The Roybel Packed Ball Joint

The Roybel Packed Ball Joint is composed of a Ball "C" (reference being made to cut) which is enclosed in a collapsible casing composed of parts "A, B, E", and flexible ring "B", and Roybel Packing "D." The collapsible casing is a mechanical construction, the feasibility of which we believe will be admitted when we say that its object is to compress the packing about the ball when required, by tightening the spanner nut "E," which operation is practically all that is required when in need of repairs on account of a leak, and can be repeated as often as required.

stood that as Roybel is a metallic packing, and has these qualities and with liberal use of graphite in its composition improves its wearing qualities and supplies the necessary lubrication for the ball joint.

The Roybel Packed Joint has been submitted to severe tests, and has been used for three years in passenger train service giving perfect satisfaction. For air and steam lines between engine and tank, also for locomotive blower and blow off lines in engine houses, the drawing shows connection between engine and tank.



DETAILS OF ROYBEL PACKED BALL JOINT.

Roybel Packing is compressed between the inner walls of the casing and the outer walls of the ball, which on account of its nature forms a hard lubricated metal seat for the ball, of such density that it will prevent the escape of fluids under pressure, and will not corrode or burn out, and as it can be readily seen the life of the joint depends materially on the packing. A word as to the packing is necessary. In the study of packing it is very plain that metal has the desired density, heat resisting, wearing and non corroding qualities necessary for an ideal packing, therefore it can be readily under-

One of the features of the Roybel Steam Heat and Air Connection is its simplicity and easy way in which the tank can be separated from the engine. All that is necessary to do is to remove cotter pin and open swivel joint. It is not necessary to touch the ball joints in any way. This connection has less parts which require packing and tightening than the connections now generally used by railroads.

Repeated tests have shown the efficacy and durability of this packing, and its rapidly growing popularity is the best proof of its adaptability.

Great Cities Unserved by Railways.

A widespread impression prevails that there would be no great cities were it not that railways tend to concentrate the population. That were it not for the railways that tend to huddle population into small areas, there could be no New York, Chicago, Philadelphia or Boston. Yet in ancient times immense cities were built and their populations managed to live.

Damascus, the oldest city in the world, had a circumference of six miles and contained in ancient times 500,000 inhabitants. Other ancient cities were much larger. Nineveh was 15 miles long, 8 miles wide and 40 miles round, with a wall 100 feet high, and thick enough for three chariots to run abreast. Babylon was 50 miles in extent within the walls, which were 87 feet thick and 350 feet high with 100 brazen gates. The temple of Diana in Ephesus was 420 feet to the support of the roof. The largest of the pyramids is 461 feet high and 653 feet on the sides; its base covers 11 acres. The stones are about 30 feet in length and the layers are 380. It employed 330,000 men in building. The labyrinth in Egypt contains 300 chambers and 250 halls. Thebes in Egypt presents ruins 27 miles round. Athens was 25 miles round and contained 350,000 citizens and 400,000 slaves. The walls of Rome were 13 miles round.

The Age of Science.

Lord Melbourne once said that he could not understand how a man like Faraday could spend his time in "fooling round with a magnet." Yet out of that fooling, proceeded the professor, had come electricity, with all its wonderful achievements, and a great industry which now employed more people than the British Army. As for Lord Melbourne, he was as dead as Martin Tupper, while Faraday was as certain of immortality as Archimedes, Galileo, or Newton. It was not sufficiently realized that the discoveries of Lord Lister had already saved more lives than were lost in the whole of the Napoleonic wars; yet people still thought more of a general or a commander of any sort than of a great scientist like him. We lived in a glorious age of glorious achievements; but, just as the age of Phidias was the age of sculpture, that of Raphael the age of painting, and that of Shakespeare the age of literature, so the age of Faraday, Darwin and Pasteur was the age of science.

A Very High Bridge.

What is claimed to be the highest bridge in the world spans the Zambesi River, at the Victoria Falls, in Northern Rhodesia, Africa. It traverses the river in one span of 600 feet, is 30 feet wide and 420 feet above the water. It was built in 1904 by a British bridge company for the Rhodesian railways trust.

RAILROAD NOTES.

The Bangor & Aroostook is in the market for 30 freight cars.

The Wabash, it is said, is in the market for sixty new locomotives.

The Canadian Pacific is reported in the market for 70 locomotives.

The Illinois Central is reported in the market for 70 locomotives.

The Missouri Pacific is said to be in the market for 100 passenger cars.

The Delaware & Hudson is in the market for 10 Pacific type locomotives.

The Georgia Southern & Florida is in the market for six locomotives.

The Texas & Pacific will be in the market in the near future for 15 locomotives.

The Detroit Terminal has ordered three switchers from the American Locomotive Company.

The Texas & Pacific will soon be in the market for 1,500 to 2,000 gondolas and box cars.

The New Orleans & Northeastern is in the market for four Pacific and six Mikado locomotives.

The Pennsylvania has ordered 34 locomotives. These locomotives are to be built at its Altoona shops.

The Michigan Central has purchased four electric locomotives from the General Electric Company for use in the Detroit river tunnel.

The Atchison, Topeka & Santa Fe is reported in the market for 1,000 freight cars. This road recently placed a large order for cars.

The Pennsylvania will issue inquiries within a few days for its rail requirements for 1914, which, it is said, will not exceed 150,000 tons.

There is now under construction for the Chicago Great Western by the American Car and Foundry Company six 60-foot all steel passenger cars.

The Chicago & North Western has placed orders for 25,000 tons of rails for main line and 9,000 tons for the Chicago, St. Paul, Minneapolis & Omaha.

The Norfolk Southern's new roundhouse at the Glenwood yards, Raleigh, N. C., is now in the course of construction. Work was started a few days ago.

Five thousand freight cars, aggregating in value about $5,500,000, have been ordered by the Union Pacific. This is one of the largest equipment orders that has been reported for months.

The Chesapeake & Ohio has ordered 2,000 gondola cars. The Standard Steel Car Company and the Cambria Steel Company will each build 1,000 of these cars.

The Buffalo, Rochester & Pittsburgh has ordered 15 locomotives. Of these locomotives 5 are to be of the Mallet type, weighing 70,000 pounds each, and 10 will be of the Mikado type, weighing 45,000 pounds each.

The New York, Philadelphia & Norfolk has awarded a contract to the Roberts & Schaefer Co., Chicago, for the building of a large reinforced concrete fireproof locomotive coaling and sanding plant at Cape Charles, Va.

The Louisville & Nashville is building an eight-stall roundhouse, and is also putting up small shop buildings at Irvine, Ky. This road will build repair shops at South Louisville, Ky., requiring about 600 tons structural shapes, contract for which has been let to the McClintic-Marshall Co.

Contracts have been signed by the Buffalo, Rochester & Pittsburgh for 1,000 new freight cars. Five hundred of the cars will be of the regulation type and size for merchandise traffic, while 500 will be of the gondola type, 46 feet in length and with a capacity of 100,000 pounds each.

All of the steel bridges on the Baltimore and Ohio Southwestern and the Cincinnati, Hamilton and Dayton lines that were destroyed or damaged by the floods last spring have been rebuilt or repaired and traffic has been resumed over all of these structures. The last bridges to be put in operation were at Hamilton, O., and Lawrenceburg, Ind.

Plans have been completed by Mr. H. C. Manchester, superintendent of motive power and machinery of the Lackawanna, for the construction of 14 freight locomotives of the Pacific type and four passenger engines of the same type, which will cost the company $450,000. They will have a tractive effort of 45,000 pounds. The weight of the latter will be 288,000 pounds each, with a tractive effort of 40,000 pounds. This new power will probably be delivered by June 1 and the freighters will haul the fast trains.

Books, Bulletins, Catalogues, Etc.

Locomotive Ratios.

The first bulletin of the year issued by the American Locomotive Company is a very valuable contribution to railroad literature and is the result of much inquiry and careful calculations by Mr. F. J. Cole, the company's chief consulting engineer. The document presents an interesting explanation of the company's method of determining the heating surface, grate area, coal burned, water evaporated, and other related proportions of locomotives. These rules are based on cylinder and boiler horsepower and on proper evaporating values being assigned to firebox, tube and flue, arch tube and combustion chamber heating surfaces. The usual practice was to proportion the heating surface of the tubes and firebox, and the grate area by the ratio existing between them in square feet and the cylinder volume in cubic feet. The volume of one cylinder in cubic feet was taken and multiplied by some figure from 400 to 600 to obtain the required amount of heating surface in square feet. This figure varied with the class of engine and condition of service.

The subject was brought up before the Master Mechanics' Association in 1897, and certain ratios were then recommended, but steam pressures and length of tubes have increased to such an extent that the older ratios are not now of service in the present day calculations. The radical changes in locomotive construction with pressures ranging from 150 to 250 pounds, and tube lengths from 10 to 24 feet, and tube spacing from 9-16 in. to 1 in., together with the use of superheated steam make it difficult to obtain even rough approximations, using the cylinder volume as a base, unless a number of corrections are introduced for each condition. Mr. Cole has succeeded in getting away from the old arbitrary and unsatisfactory method of designing locomotive heating surface by cylinder ratios, the idea of using the cylinder horse-power suggesting itself as forming a very desirable basis for the heating surface, grate area and tube area. A series of tables are presented in the bulletin from the most recent available data. It is shown that with saturated steam the average maximum horse-power is reached at about 700 feet piston speed per minute; constant horse-power at 700 to 1,000 feet piston speed, and then slightly decreasing at higher velocities.

Reports from the testing plant of the Pennsylvania railroad at Altoona are skilfully introduced and conclusions are reached that a horse-power can be obtained from 25 to 29 pounds of saturated steam in simple cylinders with piston speeds of 700 to 1,000 feet per minute. A fair average value has been taken at 27 pounds, and in a similar way 20.8 pounds for steam, superheated 200 degrees and over. The evaporation of combined firebox and tube heating surface in a locomotive boiler having 2¼ in. tubes, 18 feet long, spaced 15-16 in., is taken at 13⅜ pounds of water per square foot per hour. While careful tests show that the evaporation can be increased under the most advantageous conditions to 14¾ or 15 pounds per hour with high degrees of smoke-box vacuum, it is considered better practice to take the lower figure in order to provide a margin for average conditions.

The lengthening of boiler tubes from 12 to 14 feet to 20 and even 24 feet have resulted in decreasing the smoke-box temperature from about 750 to 800 degrees, to 550 to 600 degrees, the only increase of energy required being the slightly greater draft in the smoke-box to pull the gases through the long tubes. The fuel economy therefore is greater, as has been shown by tests in the modern engine, than in older types, as the range of temperatures at which the engine works, that is, the difference between the temperature of the furnace and that of the stack with the long tube locomotive, is greater.

Through the series of tables, as we have stated, there are an array of facts and figures and illuminating data that is so co-related that with unerring accuracy the effect of each variation in dimensions in the principal parts of the locomotive is shown with the corresponding effects on horse-power and velocity with the amount of water evaporated for each pound of coal. From this mass of data it is readily discoverable what may be expected from any design of locomotive, as well as to construct locomotives to meet the expectations that may arise from any particular situation.

It may be added that the method of proportioning referred to and which is so fully and clearly described in the Bulletin has been used by the American Locomotive Company for the last three years in all their locomotive designing. It is during this period that Mr. Cole has had ample opportunities on numerous road tests, laboratory tests, and records of engines in service that have been investigated and carefully compared with the tables of ratios, and the collected results have been adopted as the Company's standard. The Bulletin No. 1017, should not only be carefully perused by all who are interested in locomotive construction and operation but a copy should be kept for reference and it will be found more useful than half a dozen antiquated cyclopedias, especially of the vintage of last century.

Pickling Machines.

Pickling means the removal of scale and other substances from the surface of metals by the chemical action of acid. If the material to be cleaned is simply soaked in acid, too much of the material is dissolved, the action is not uniform on account of the varying density of the acid, and the cleaning is both uncertain and uneven. The older method was to create disturbances by hand, but it was always inefficient. The modern pickling plant secures agitation that is effectual by machinery. The Mesta pickling machine saves about half the acid and nearly all of the time required in hand pickling. The scouring action caused by the ingenious mechanical appliances thoroughly cleans the sheets. The latest improvement in the Mesta system of pickling has the double merit of pickling and washing at the same time. One crateful of material is being pickled while another is being washed. Full descriptions may be had by perusing Bulletin M, copies of which may be had on application to the Mesta Machine Company, Pittsburg, Pa.

Grinding Wheels.

The *Abrasive Age*, an illustrated, descriptive periodical published by the Carborundum Company, Niagara Falls, N. Y., is of real interest to all who grind. The new Queen City grinder is the latest in perfection of detail and adaptability to every variety of work. The speed and accuracy, as compared with the older methods are amazing. In the matter of tool grinding it is almost past belief to be informed that in the case of the larger kind of knives, measuring six feet in length and four inches in width, about four hours time was saved and the services of five expert workmen were dispensed with—not sent adrift to look for other employment in mid-winter, but placed at other profitable employment, after introducing the grinding wheels in the place of the old-fashioned grindstone. This is but a sample of the revolution worked to an enduring perfection by the introduction of carborundum. Send for a copy of any of the company's publications and be enlightened.

Graphite.

An interesting feature of the *Dixon's Graphite*, illustrated publication is the brevity with which it tells valuable truths. One does not have to wade through pages of theorizing. As a sample we are tersely told that "graphite has been brought into prominence as a boiler scale preventive and many engineers will testify that it has produced beneficial results. Its action is mechanical rather than chemical. Fed into the boiler with the water at regular intervals and in stated quantities, it tends to form a coating on the heating surface of the boiler which prevents the scale from adhering. The graphite also intermixes with the crystals of the scale-forming impurities and prevents them from cementing solidly together, so that they exist only as a sludge or form of mud, which can be easily blown out." Now, if this truth was left in the hands of some one full of words, he would write a book. At the same time the Joseph Dixon Crucible Co., Jersey City, N. J., has a number of books and pamphlets on this and similar subjects, copies of which may be had on application.

Feed Pumps and Heaters.

Messrs. G. & J. Weir, Glasgow, Scotland, has forwarded to us a copy of their elegant descriptive catalog explanatory of what is known on British railroads as the Weir system of feed water heating and pumping. The system is based, of course, on the fact that under older methods a portion of the heat formerly carried out of the boiler and involving a direct expenditure of fuel may be saved. This includes the exhaust steam from the cylinders and the waste gases from the furnace. The attempts to utilize these lost forces are legion. Their success has been hardly visible to the naked eye. The success of the Weir system is vouched for by eminent British authorities and a saving in fuel claimed amounting to as high as 16 per cent. We cannot at this time begin to describe the details of the appliance, but will refer to it fully at an early date. Meanwhile all interested may secure copies of the illustrated, descriptive catalog on application to the Messrs. Weir, Cathcart, Glasgow, Scotland.

Electric Turntable Tractors.

It is gratifying to learn that the enterprising firm of Geo. P. Nichols & Bro., 1090 Old Colony Building, Chicago, has received an order from the Cleveland, Cincinnati, Chicago & St. Louis Railway Company for nine of the standard electric turntable tractors for different points on their system. The company has already installed a large number of their improved tractors on various railroads, but this is the largest single order for electric turntable tractors ever placed by any railroad, and is a proof, if proof was necessary, of the growing popularity of this company's fine products. Send for catalog.

Duff Manufacturing Company.

The Duff Manufacturing Company, of Pittsburgh, Pa., builders of lifting jacks, have opened an office in the People's Gas Building, Chicago. Backed by a Chicago warehouse, they will be in a position to give Western customers increased service and prompt deliveries of "Barrett" track and car jacks, Duff ball bearing screw jacks, Duff-Bethlehem hydraulic jacks and the numerous variations of

these main types of lifting jacks manufactured by them. The company has also appointed Mr. G. W. Parsons district sales agent, with offices in the Pioneer Building, St. Paul, Minn. By mutual agreement, the Fairbanks Morse Co. have discontinued acting as exclusive steam railway agents for the above company.

National Tube Company.

One of the most popular "National" bulletins recently issued by the National Tube Company is No. 18A, on the subject of "National" Reamed and Drifted Pipe. This publication contains a complete description of this product, together with a short introduction explaining the process of well driving and information relative to the various accessories necessary for the driving and pumping of wells.

In the same month another bulletin, No. 19, has been issued by the same company, giving a complete list of their products. The list gives an idea of the vast and varied products of the National Tube Company and the constant additions that are being made to them, and all of which are the exclusive rights of the company. Copies of these and other interesting bulletins may be had on application to the company's main office, Frick Building, Pittsburgh, Pa.

Compressed Air Practice.

This is a volume of 326 pages, 4 x 7 inches, written by the best authority on compressed air. The subject is one which deserves more attention than it receives, for, as the author tells us, "Man is constantly and absolutely dependent upon air for his life and for satisfaction and accomplishment in life. He can survive without solid food three weeks, without water three days and without air three minutes." That is a quotation from the chapter on "Atmospheric Generalities," which in itself is an admirable treatise on the subject, brimful of information which will be new to most readers, since it recounts in a striking manner the functions automatically performed by atmospheric air in many of the operations of nature.

The book is made up of twenty-eight chapters, each dealing with a department different from the others but each one comprehensive in its line. Among the striking subjects thus treated are, Definitions and General Information, Single-Stage Compression, The Drive of the Compressor, Power Cost of Compressed Air, Pipe Transmission, Gasoline by Compression, Liquid Air—Oxygen from the Atmosphere.

Some statements are made which seem curious, for instance: Just think of it. Ordinary city gas is transmitted and stored and distributed at pressures as minute as not to be measurable in pounds to the square inch, as we commonly measure and record pressure, or even in ounces, but in tenths of an inch of water.

The author, Mr. Frank Richards, is an eminent writer on engineering subjects, and the work is published by McGraw-Hill Book Company. Price $3.

Proceedings of the National Association of Railway Commissioners.

The proceedings of the twenty-fifth annual convention of the National Association of Railway Commissioners, held at Washington, D. C., in October last year, have just been issued by the Law Reporting Company, 115 Broadway, New York, and forms a bulky volume of 612 pages bound in cloth and sold at one dollar per copy. The work includes all committees' reports and the discussion thereon, and cannot fail to be of real value to all interested in the management of railways. The mass of information conveyed in the volume is such that there is scarcely any topic at present touching American railways but is discussed with a degree of fulness and fairness that is not approached by any other publication. Especially noteworthy is the section devoted to the powers, duties and work of railway commissioners. On this subject even the best informed railway men are greatly in need of enlightenment. It is greatly to the credit of the association that this important publication has been prepared and published at the expense of the commissioners themselves, although Congress every year appropriates large sums of money in printing volumes whose use is past finding out.

Street Locomotive Stoker.

The Locomotive Stoker Company, 30 Church St., New York, have issued a new catalogue, No. 13, of 24 pages, with descriptive matter and 20 illustrations. The stoker is the result of seven years' development work, and has been built in three different types. There are now in operation over 400 locomotives equipped with this appliance, and it has been demonstrated beyond controversy that the saving by the use of the Street stoker has shown a marked increase in the tonnage hauled by the locomotives, by reason of maintaining a maximum steam pressure at all times, thereby reducing the overtime of crews, and affording the firemen time to attend to the main details of the working of the engine as well as watching signals, and, as has been clearly shown, reducing the cost of repairs. Of the details of the appliance we will take the matter up in an early issue.

There is no longer any inaccessibility, no longer any enchanting unexpectedness, and life turns to prose the moment there is nothing unattainable.

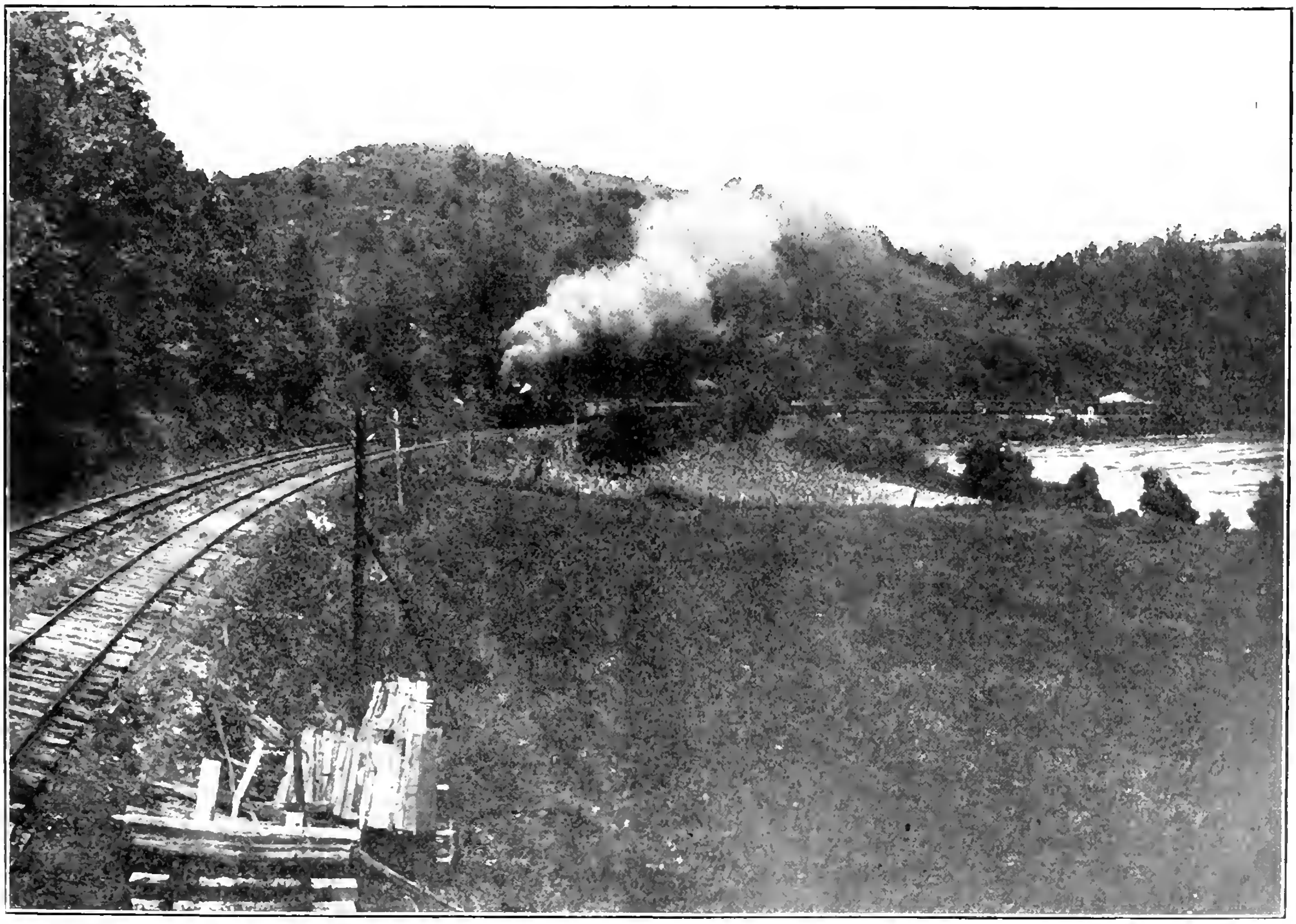
Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, April, 1914. No. 4

Developments on the Southern Railway

The severe weather in the North and West during the early part of the present year has caused an extra influx of tourists to the South, and the great popularity of the Southern railway was never shown to better advantage than in the superb accommodation furnished to the travelling public and the increasing number of delightful resorts. From Washington, D. C., Cincinnati, Ohio, and St. Louis, Mo., as the northern extremities of the great system to Jacksonville, Fla., Mobile, Ala., and New Orleans, La., as the extreme southern terminals, there is a vast territory favored with almost everlasting mild temperature, with blue and brilliant skies, genial air and balmy sunshine, where outdoor life is always enjoyable, and where the gorgeous scenery is in eternal bloom.



ON THE SOUTHERN RAILWAY, MOUNT RIVER, NORTH CAROLINA.

Beginning with the Richmond & Danville Railroad in 1847, nearly eighty different railway companies had established branches in various parts of this great territory until, in February, 1894, the Southern Railway was chartered, and from that date the growth of the great railway, made possible by the unification of the various small roads, has been rapid. At the present time it extends to 7,030 miles of track, with 1,629 locomotives and 51,515 cars of all kinds in service. In addition to the mileage referred to, there are also lines leased and operated extending to 2,200 miles, so that the present year will likely see a system of tracks owned and leased by the company extending to 10,000 miles, and second in extent only to the Canadian Pacific, which extends to

over 11,000 miles of track in operation.

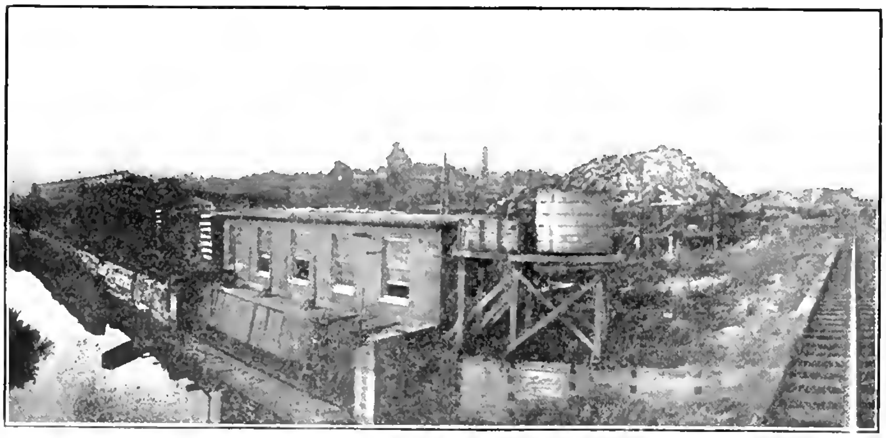
With the superb through limited trains operated daily throughout the year by the Southern Railway between New York and the South, it is little wonder that so many Northern tourists visit the South by the railway system. These splendid trains comprise the New York, Atlanta and New Orleans Limited, the Southern's Southeastern Limited, Memphis Special, Washington & Chattanooga Limited, Birmingham Special and United States Fast Mail. All of these trains carry the latest types of Pullman equipment. In addition to these palatial trains a new all-steel train has been inaugurated between Chicago, Ill., and Jacksonville, Fla., by the Big Four Route, Queen & Crescent Route and Southern Railway, and other specials are being established between other points, so that communication from every part of the country is now nearly completed in a system of daily trains that are reliable in point of time and complete in equipment.

It would be idle to point out any particular region as being more peculiarly favored than another, as individual tastes naturally lead to such selections as are most congenial, but there is a generally mistaken idea in regard to the climatic conditions that prevail in the South. It may be stated briefly that the Cumberland, Smokey and Alleghany mountains cover an area that contain in themselves the elements of almost every clime. The mountain peaks that tower nearly 7,000 feet in height are cooler in summer than the Adirondacks or Catskills, while the sea coasts of the Carolinas and Florida and the Gulf of Mexico are the regions of eternal spring, where the extremes of heat and cold are unknown.

The hotels and association buildings that are rising in architectural beauty everywhere in these favored regions are numberless and unsurpassed in the elegance of their accommodations, and one visit will convince the most fastidious that here is the land of rejuvenation.

Apart from these attractions, however, which are largely taken advantage of by those who may be said to be possessed of means and leisure, there is an immense development of industries of almost every kind in the South, made possible by the great and growing railroad. In the mountainous districts the lumber industry bids fair to outrival the West. In the cotton belts the introduction of every kind of machinery has brought colossal factories into being that keep the growing population well employed all the year round. Among the people there is a spirit of contentment not common in the North. This is particularly noticeable among the railway men, where the feeling between the officials and employees seem to be of the kindliest. There seems to be less hurry and worry and more of a live-and-let-live spirit, with the result that strikes are unknown and periods of depression, if they do come, are unfelt.

NEAR GRAPHITEVILLE, NORTH CAROLINA.



PIGEON RIVER FROM THE RAILROAD BRIDGE, NORTH CAROLINA.

At the same time it is easily to be perceived that the equipment of the Southern railway is kept in a high degree of efficiency. The tracks that were long a standing hindrance to high speed are now almost completely in excellent condition, and an extensive system of double-tracking between the principal cities is being carried on, that shows the determination of the officials of the Southern Railway Company to make a roadway through the sunny South second to none.

In the brief period of time that we had an opportunity of mingling among the railway men it was pleasant indeed to mark the universal spirit of gentlemanly courtesy everywhere observable, not only to the travelling public by those engaged in the transportation department, but among the railway men, as we have already stated, towards each other. This is peculiarly pleasing not only as showing the genuine spirit of true democracy, but that other spirit of Southern chivalry which did not have its origin in democracy, but is rather a lingering echo of old-world gentility characteristic of the early cavaliers that founded new homes in a new and magnificent country.

Last Narrow Gauge Railroad in Georgia.

A ripple of railroad excitement has recently stirred Monroe, Ga., caused by the widening of the Gainesville Midland Railway to the standard gauge. When the excitement favoring the construction of narrow gauge railroads was in season, the State of Georgia became enthusiastic for that form of railroad and considerable narrow gauge mileage was put into operation, but the advantages anticipated—cheap construction and cheap operation—were soon found to be fallacious, and now the end of the fallacy has come in the Gainesville Midland being changed, ending the last narrow gauge railroad in Georgia.

Railway Invention.

The Great Western Railway of England has undertaken the investigation and patenting of inventions relating to mechanical contrivances likely to be of use on railways that are suggested by any of their employees. This does not in any way prevent men in their service from offering their inventions elsewhere, but it is thought that it may help men engaged in railway work and not in a position to take out patents to make known ideas which may prove of great use. Other railway companies, recognizing the soundness of the scheme, have similar projects under consideration.

Converting Inferior Fuel Into Briquettes

The vast quantities of waste coal accumulated about the mines in various parts of the country constitute a possible combustible that will add greatly to the fuel resources of the United States if put in the condition to be utilized. We are pleased to find that the United States Government through the Bureau of Mines is acting vigorously to put refuse coal into the form of briquettes, which produce as good and sometimes better heating elements than the coal from which the stock was wasted. The same bureau is also laboring to put into combustible shape various other inferior fuels, such as lignites, peat and inferior qualities of coal.

In the past numerous attempts have been made by various interests to make fuel briquettes and the failures have been so uniform that many engineers regard the making of briquettes as visionary schemes that produce fuel which cannot be used successfully in competition with mine coal. The Bureau of Mines report that the failures referred to were due to the following causes:

1. Many of the "plants" represented promoters' schemes, no attempt being made to build the plants.

2. Attempts were made to develop a new binding material or a new press, without proper appreciation of the principles of briquetting.

3. Plants were poorly situated for marketing the briquettes.

4. The briquettes produced were inferior. Briquettes containing an excessive amount of pitch binder have been placed on the market, with the result that after one trial householders were disgusted with the soot and odor produced. Results of this kind are especially harmful to the development of the industry, as it is very hard to overcome a prejudice against briquettes when once it is created.

5. Poor salesmanship has been responsible for other failures of briquetting ventures. As briquettes are a comparatively new and untried form of fuel careful salesmanship to introduce them is required. As many retail coal dealers are afraid that the new fuel will supplant the usual fuels they do not encourage the introduction of briquettes; some even tell their customers that briquettes are made of dirt and have practically no heating value. Therefore, to build up a successful business in fuel briquetting requires much advertising and demonstration, not to mention capital and time.

6. Uncertainty in the supply of raw fuel or binder has caused the failure of many briquetting plants.

7. Lack of technical supervision has in some instances been the direct cause of failure. Certain features of briquetting, notably suitable binder, proper temperature, and the influence of moisture, are all problems that require technical investigation and chemical control. The making of satisfactory briquettes involves considerably more than the possession of suitable machinery. Slight variations in the quality of binder used may make all the difference between success and failure, as the binder is the largest item in the briquetting cost.

The most favorable outlook for the development of the briquette industry in the United States is for use in locomotives and in domestic furnaces. The fuel-briquetting industry has passed the pioneer stage and is making steady growth each year. There were in opertion in 1912, 18 fuel briquetting plants, all of them doing well. Briquettes when properly made possess the following advantages over raw fuel:

1. The even size of the briquettes permits a more regular and thorough combustion in the firebox or furnace.

2. They produce much less smoke, and, in many cases, practically no smoke. This feature of briquettes is more noticeable with the smaller sizes than with the large rectangular blocks. On account of the number of flat surfaces the latter tend to pack together, thus preventing free access of air. If an excessive amount of tarry pitch is used some smoke will be given off.

3. Good briquettes retain their shape in the fire, and do not cake sufficiently to cut off the supply of air to the upper surface of the fire.

4. Briquettes usually burn to a fine ash without clinkering. In the briquetting process the mixing and grinding distributes the ash or foreign material, which forms lumps and layers in the raw coal. When raw coal is burned many of these lumps and layers, being too large to pass the grate, are fused into clinkers.

5. A briquette fire requires much less care than one of raw fuel.

6. The evaporative power of briquettes is greater than that of coal in its natural condition. This advantage has been found to exist at all rates of evaporation.

7. The weather-resisting qualities of many coals, especially lignites, are greatly improved by briquetting.

8. Steam can be more quickly and easily raised with briquette fuel than with run-of-mine coal.

9. Higher rates of combustion are possible with briquettes than with run-of-mine coal.

10. The loss from breakage during transportation of good briquettes is less than with run-of-mine coal. This loss should not exceed 5 per cent.

11. The possibility of spontaneous combustion is eliminated if the fuel is stored in the briquetted form, and for this reason fuel in the form of briquettes is favored by European countries.

12. The large block-shaped briquettes may be piled in regular rows, and occupy less space per ton than the run-of-mine coal. However, the egg-shaped or cylindrical briquettes occupy more space than the run-of-mine fuel.

13. Briquettes have a higher heating value than the raw fuel from which they are made, by reason of the higher heating values of the binders and the loss of water, especially in the case of lignite, during briquetting.

That the industry bids fair to grow rapidly is the opinion of many.

Effect of Superheated Steam on Motor Cars.

When the use of automobiles first became popular steam-driven motors were popular, but a change gradually intervened and gasoline engines monopolized the field. Now another change seems to be in progress, the use of superheated steam bringing the steam engine back into use.

A leading authority on automobile and commercial motor vehicles recently read a paper on motor vehicles in which he asserted that the repairs to gasoline motors of this kind for five years amounted on an average to 35 per cent. of the original cost against 25 per cent. in the case of the steam type. He is emphatic on the advantage of superheating since it not only reduces the fuel consumption but also decreases the consumption of water, a point of great importance in a country where water is scarce. His firm, the writer says, have recently constructed a six-ton steam wagon fitted with a feed-water heater and a superheater, superheating the steam to 600 degrees Fahrenheit at 300 pounds, which ran 150 miles on 250 gallons of water.

Ancient Arts Revived.

Most of the mechanic arts as now followed are of modern development, but we occasionally identify processes and arts that seem to be as old as civilization while only brought into popular use within the memory of man. Tube making is one of the most important branches of the iron and steel trades, and is of strictly modern development, but it is a fact that iron pipes were used to distribute water in palaces and other buildings erected long before our era.

Among the Railroad Men in the Blizzard

By James Kennedy.

People are divided in their opinions in regard to the truth of the tales told by Dr. Cook and other arctic explorers of their experiences in the white North, but there is no doubt about the stories of the railroad men who struggled three days and three nights in the blizzard that swept the Atlantic States from Virginia to Maine early last month. From all accounts the storm center seemed to be in New Jersey. The long, level stretches between New York and Philadelphia became a cyclonic snow-wreathed wilderness. At the Pennsylvania depot in New York there is an inscription, each letter of which is as big as a storm-window, setting forth that "neither snow nor wind nor rain can keep these fleet-footed messengers from fulfilling their courses." The inscription should now be covered with reinforced concrete or Portland cement. It has outlived its short period of blatant boastfulness. If the massive entablature had used such simple words as: "We will do our level best"—or something like that, it would not now be such a source of mocking merriment.

The trains went out heroically in the teeth of the tempest, and ran as far as they could. The entire State soon became dotted with stalled trains, some completely covered in snow drifts 20 feet deep and two-thirds of a mile in length. The starry snow-flakes were of such an unusually adhesive texture that they hung on the telegraph wires like fleeces of wool, and the poles that had seen better days came crashing down here and there.

An engineer in the Jersey Central went forward to open the injector, and a telegraph pole came down on the cab with about a hundred wires on it, and the other poles promptly followed like a wild wave thundering on the reef. And the crashing of the poles and the cross-arms on the moving car-roofs, and the shrieking of the tempest made up a pandemonium that would have silenced the battle of Trafalgar, or a thunderstorm in the Alps.

A snow plough on the Reading, working overtime on a 15-foot snow-drift, snapped off as if the shaft had been of wood, and in ten minutes the engine and crew were covered as with a white mantle and the broken plough lay in the snow for a week. Four locomotives came to the rescue, but they had to be rescued themselves. The whole five had to be shovelled out by hand.

In some cases the locomotives were detached and attempted to clear a way alone, and engine and train were both smothered miles apart. Some crews kept up the battle, running short distances and stopping and chopping broken telegraph poles and clipping wires, to be at last overcome by sheer exhaustion, and sat down in the cabs for two days and nights to ruminate on the vanity of human endeavor against the war of the elements.

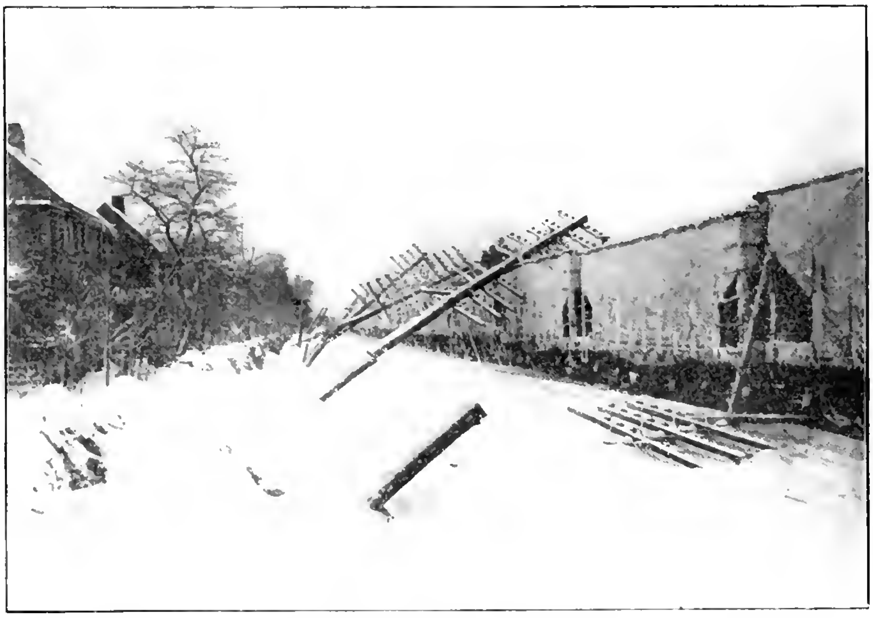
Some trains with nearly 100 passengers were left in utter darkness, and the helpless people sat in huddled misery until the kind-hearted country people came like good Samaritans and cut a path for them into the white world again. On one train sixty-four cattle were stalled, but the neighboring farmers joined forces and found means of leading the bewildered beasts to safety, and fed the flock for a week. About 400 chickens in one stalled car mixed their shrill cries with the voices of the storm, but as nobody seemed to care for early spring chickens, the feathered flock gradually stiffened into cold storage. A carload of pigs squealed in vain. Their shrieks resembled the voices of the tempest so closely that no one noticed the additional clamor, so the snow soon became the winding sheet of the frost-bitten hogs.

A curious case occurred on the Reading about 26 miles north of Philadelphia. One woman and four men were in a stalled car out of sight, and a gallant schoolboy found a way to relieve them. The men, in their desire to forget their miseries, eagerly inquired about the nearest tavern. They were hopeful of getting comfort from an old friend there named Apple Jack. The woman went with the boy to the neighboring schoolhouse and studied the map of New Jersey. Who can deny, after this, the moral and intellectual superiority of woman?

At the roundhouses the turntables became unworkable on account of the snow and the lack of power, so hundreds of locomotives, throbbing at every rivet, as if eager to engage in the war of the elements, had to stay on the reserves. The locomotives that were at large made fierce attempts at forcing their way, and came back from labor to refreshment of coal and water only to find that each repercussion was met with increasing obstacles like strong men fighting against a flood of ever-increasing misfortunes.

Coming back to New York, strange to say, that the first time in the history of the imperial city, a locomotive and train were held up in Eleventh avenue. The train had crawled along at a slow pace, and stopped near an establishment justly celebrated for its fine quality of Budweiser—whatever that is—and the half-starved crew jumped off to refresh themselves. They were in no great hurry to come back, but when they did come, and the engineer slowly opened the throttle the engine refused to move. Were the cylinders frozen, or the snow too deep? Both pistons could not be on the dead center. It would take too long to consult the Question and Answer department, so the train just stood there as if waiting for further orders, and Underwood & Underwood, the enterprising photographers, sent one of their clever artists and caught them with the camera just as they stood.

There are too good lessons to be learned from the blizzard. The first is the feebleness of frail humanity against the elemental forces of nature. The second is that there are no class of men

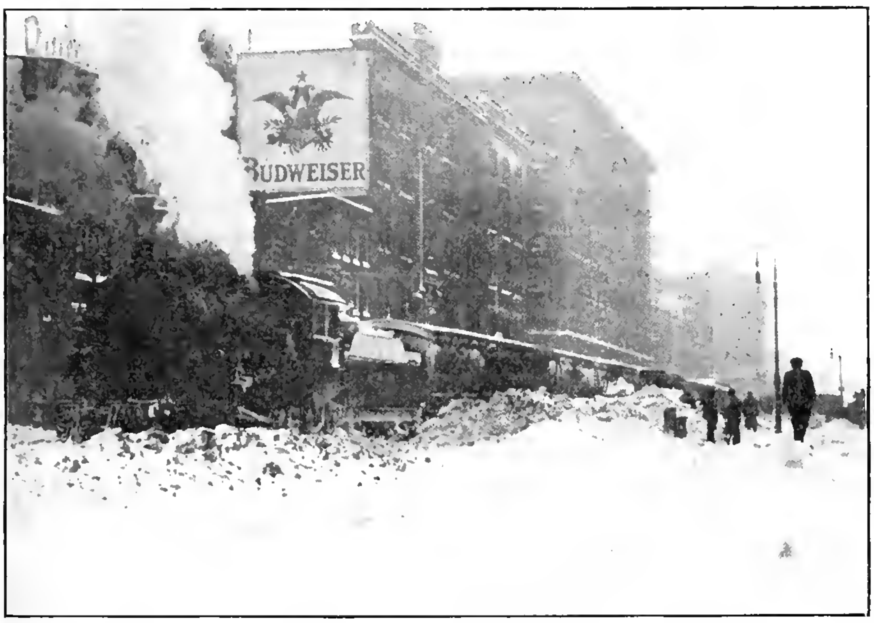


ON THE CENTRAL RAILROAD OF NEW JERSEY, NEAR BOUND BROOK.
Photograph by Underwood & Underwood, N. Y.

more heroic than the railroad man. In spite of the fact that there are more than 10,000 people killed every year on American railroads, the railroad man never flinches. While the burden of labor seems heavy, it sits lightly on him, and he looks the spectre with the scythe square in the eyes. Many of the engineers and firemen last month had a map of the Tenth Ward cut in red lines on their faces by the flying splinters of glass from the cab windows, when the iron horse was careening through 3 or 4 feet of ice-sheathed snow and the flying splinters came rattling like grape-shot against the crackling cab windows, but the stern hand remained at the throttle just the same as if nothing unusual was happening.

Sometimes a railroad man gets it in the neck very undeservedly. During the early part of the blizzard a night foreman telephoned to the store-room for bolts to fasten some temporary snow ploughs. There were no bolts of the kind available. Next day the general foreman gave the night foreman a piece of his mind for daring to call for supplies in his absence. Next night the snow deepened and the night foreman kept silent. Next day he was promptly discharged. There had been danger and delay, and there had to be a "goat" found somewhere. The night foreman had only been recently appointed, and so he was the easiest victim, and outraged authority, or superior incapacity, rather, felt appeased at his discharge. He is a most accomplished mechanic and engineer, and takes the matter philosophically. He will be a master when his sometime inferior superiors may be peddling soap. All things come to them that wait.

Now the blue-birds are prophesying spring, and the blizzard will soon be but as the white ghost of a vanishing memory.



NEW YORK CENTRAL TRAIN HELD UP ON ELEVENTH AVENUE, NEW YORK.
Photograph by Underwood & Underwood, N. Y.

A Bagdad Railway.

Nearly every intelligent person has read the Arabian Nights with the doings of Caliph Haroun Al Raschid in the great and ancient city of Bagdad. That city was founded in the eighth century and attained its highest splendor a century later when Haroun Al Raschid was Caliph. The population was said to have reached at that time 2,000,000 persons, but under Turkish rule it has now fallen to about one-tenth that number.

Bagdad on the Tigris river was originally surrounded by what has been considered the finest wheat-growing regions in the world, the valleys of the Euphrates and Tigris, but want of irrigation and other causes have turned these once fertile valleys into semi-deserts. Schemes for bringing back the regions to the ancient fertile conditions have been projected and are likely to be carried out before many years go by. Meantime the construction of a Bagdad railway has been occupying the attention of several European nations.

Germany has been prosecuting a project of that kind very vigorously, the Kaiser himself having been one of its strongest advocates. The railway was to furnish to Germany entrance to the Middle East and a means of checkmating the increasing power of Great Britain and Russia. There were to be two seaports in Asiatic Turkey, one opposite Constantinople, the other on the coast of Asia Minor. The arrangement, had it been carried out, would have enabled Germany to carry trains loaded with troops down the Euphrates valley, thence by a near cut to a port on the Persian Gulf, thus avoiding passage through the Suez Canal.

Besides its political features the Bagdad railway had great attractions to the civilized world, for it was to open up to easy transit the grand Euphrates valley, the scene of biblical history and ancient civilization. The line was to pass by the sites of Nineveh and Babylon, through ancient Assyria and part of Persia.

Great Britain has always opposed any schemes which were likely to open the way for other nations to India, and this German encouragement of the Bagdad railway attracted active opposition. This led to an Anglo-Turkish agreement which gives Great Britain what is really a controlling interest in the Bagdad railway, which will prevent its construction into regions that might prove dangerous to British security in India.

The indications are now that within five years tourists may be able to take trains from Berlin to Bagdad.

Great Engineering Work in Mesopotamia.

In ancient times Mesopotamia was one of the most fertile regions in the world, the Tigris and Euphrates rivers having supplied it with sufficient moisture to produce immense crops of wheat and all kinds of fruits. The neglect common to Turkish rule has turned much of Mesopotamia into great swamps, scenes of desolation. In connection with the pushing of the Bagdad Railway and other public improvements the Turkish government has lately undertaken to control the floods of the Euphrates river, and an immense barrage has been built to convey the flood water into another channel.

The opening to the new channel was accompanied by impressive ceremonies in which great crowds of people took part. A well-known Mullah said a prayer, and His Excellency, the Vali, removed two or three spadefuls of earth from the dam. He then handed the spade to the Kadi, who followed his example. Afterwards, at the Vali's invitation, Mr. Whitley also removed a spadeful. The Arabs then sacrificed some twenty sheep on the top of the dam, and after the carcasses had been removed about forty Arabs lined up on the dam and at a given signal commenced to dig it away. As they entered into the spirit of the thing the water soon found its way through. As soon as there was a fair amount of water on the lower side of the dam a number of Arab women dashed into it and washed their faces in it in the hopes that by so doing they would become mothers of sons.

In the course of the ceremonies His Excellency, the Vali, made a speech in which he expressed pleasure in having the honor to assist at the inauguration of the first of a number of schemes for irrigation which, when all were completed, would bring the Irak back to the position which she occupied at one time among the nations.

The results of the influx of water will, no doubt, be watched with interest.

General Correspondence

The Southern Railway Machinists' Rates of Wages.

EDITOR:

Mr. W. T. Kearsley places the matter of machinists' wages in the South very fairly in the March issue of RAILWAY AND LOCOMOTIVE ENGINEERING, and he has not overestimated the advantages enjoyed by the men of the South as compared with those in the North. Not only so, but it should be added that in the necessary reductions made by the railroads in the South in adjusting their transportation expenses to the new situation they have been compelled to reduce the forces at many points, and while this has extended to all branches of railroad service, because there is less traffic and fewer trains to be handled, and as a consequence the work in the shops was cut down, and numbers of men placed on furlough or short time. The principal reductions were made among carpenters, painters, tinsmiths and masons, and the machinists have been particularly fortunate in having had to experience the change in a much less degree than many other skilled mechanics, so that as a class they have not had much cause for complaint.

As Mr. Kearsley points out, the complaints coming from the North were somewhat indefinite. No particular places were named, but the presumption is that New England was referred to. The financial management of the leading railroads in that section needs no comment. Those who have been compelled to work there under such management as prevailed in the past should be glad that they are alive, and they should live in hope of better days.

Some roads in the South are paying machinists as high as 45 cents an hour. Of my own knowledge the Chesapeake & Ohio is paying 39½ cents an hour; the Richmond, Fredericksburg & Potomac, 42 cents; the Southern, 41 cents; the Baltimore & Ohio, 36 cents; the Western Maryland, 36 cents. Now you will admit that these are fair rates of wages in a section of the country where the population is less dense and traffic much less than in the North and East, and there is something wrong if the machinists in the North are continuing to be paid at the same rate as they were thirty or forty years ago, and the hope is that our Northern brethren will begin to bestir themselves and try and get a little more remuneration for their services than they are getting. They will never get more unless they ask for it. J. C. RUSSELL.

Richmond, Va.

Slide Valve Troubles.

EDITOR:

As a constant reader of RAILWAY AND LOCOMOTIVE ENGINEERING and fully realizing its vast and varied educational advantages, I would ask the liberty of adding a word to the discussion on the subject of hard-working slide valves. In the first place, this trouble is no doubt the cause of the excessive wear of the parts of the valve gear, especially on engines equipped with the Stephenson valve motion. Proper lubrication of piston valves on superheated engines has been one of the most difficult problems to overcome, but by the production of finer quality of oils, that are well adapted for this purpose, a marked improvement has been made. Packing rings also are being manufactured of better qualities of metal, that are not only more durable but lessen the frictional resistance.

In the matter of improved practices it has been found advisable to leave the throttle partly open when drifting or approaching a station or before stopping at any time. An advantage is also obtained by the use of an auxiliary valve connected to the steam chest admitting a small jet of steam through a pipe leading from the cab. This valve could be opened before the throttle is closed, which would leave a light pressure in the steam chest and cylinder and has the effect of keeping the packing rings from burning out. It also greatly lessens the jar caused by the reciprocating parts at each end of the stroke, which is such a noticeable characteristic of the larger type of locomotives.

It is interesting at any of the terminals where trains are being made up to observe the engineer or fireman vigorously tugging at the reverse lever in a determined effort to move it backward or forward, and one cannot help thinking that some intelligent effort should be made to remedy this growing grievance.

It is also of interest to ride on almost any of the locomotives and listen to the constant rattle of the reverse lever when the engineer is trying to increase the speed of the train. This will convince any one that there is some excessive friction somewhere. This is where the mechanical engineers should endeavor to have parts constructed of less weight, and of less frictional resistance, and it would not take much time to discover that the trouble is in the severe friction incidental to the motion of the slide valves, either from defective lubrication, excessive weight or not being fully and properly balanced.

If these defects were remedied, much fuel would be saved, and then the engines could be run with the throttle valve wide open and the valve running at a short cut-off, because the locomotives would not be going at a hop, skip and a jump, as if dancing a jig, when the lever is being hooked up.

It would also result in increasing the number of miles run without break-downs, besides a saving in fuel. I am sure that when our efficient instructor on fuel economy and smoke abatement, Dr. Argus Sinclair, wrote his valuable treatises on these subjects he had all valves properly balanced and lubrication attended to before starting on his educational work years ago.

In closing I would only repeat what I have already stated, that the trouble is almost entirely in the steam chest, where power is lost and steam wasted, not only on the older types of engines, but on the latest and most improved types of the modern locomotives.

WILLIAM H. W. ROBERTS.
Cincinnati, Hamilton & Dayton Ry.
Cincinnati, Ohio.

Slipping.

EDITOR:

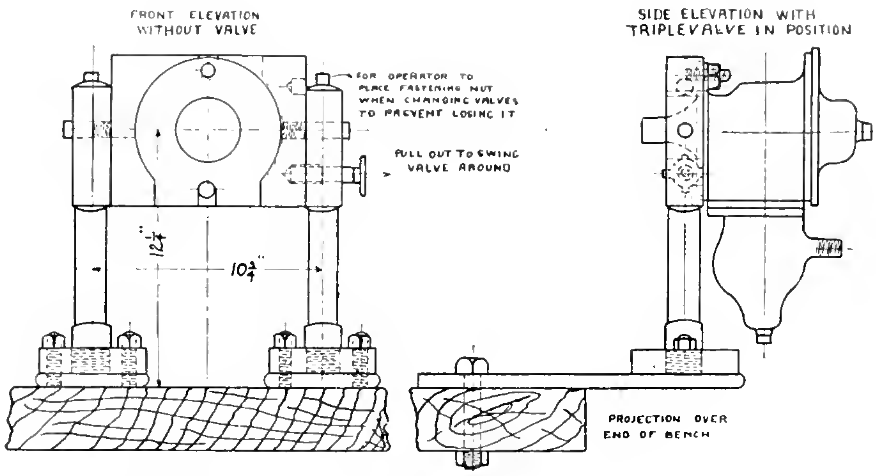
Slipping may not be an important item in the tear and wear of a locomotive. I have even heard it stated that occasional slipping was good practice, for the reason that if anything was going to be broken such breakage when the engine was standing or going slowly would result in much less damage. However, the prevention of slipping is a precautionary measure with me and there are two points in regard to this matter that I recently observed. They are these, when pulling hard and about to take a cross-over or turn-out, it is well to ease off on the throttle. On a sharp curve the wheels on the inner rail naturally tend to rotate slower than those on the outer rail. Hence a slight slipping occurs on that side of the engine which decreases the rail adhesion, and in the majority of cases the engine will slip violently. This is not a mere theory, as I have observed it many times.

Again when running slowly and working hard with a heavy train, an engineer will often set the throttle and without touching it the engine will alternately slip and take hold, because the throttle being open too much allows the steam chest pressure to rise to a point where it is re-

lieved by slipping, whereas if the throttle is eased off little by little the point will be found where the tendency to slipping will cease, and then the train can be picked up much more rapidly and proceed without trouble.

William G. Landon.

New York, N. Y.



DEVICE FOR HOLDING TRIPLE VALVE WHILE CLEANING.

Repairing Triple Valves.

By W. S. Eyerly,

F. A. B. Shops, B. & O. R. R., Mt. Clare, Baltimore, Md.

The manner of handling triple valves as they pass through the repair shops has been touched on at various times, and I do not believe it would be out of place to put this subject before your readers once more to ascertain the most economical method for handling this class of work. Both from a point of efficiency and output, as is well known nearly every shop in the country has different methods of handling their repair work, and to this end, enclosed herewith is an attached print showing triple valve cleaning stand which I have had in use for some time and is giving excellent results both relative to output and efficiency in workmanship. As is well known by those who handle triple valves repairs in large quantities, that the proper cleaning of the slide valve, its seat and other parts is an important factor in maintaining a fair percentage of the cleaned triple valves passing the test rack, and my object in building a triple valve cleaning stand of this type was to have it so arranged that the valve could be readily turned to any position most convenient for the cleaner; for instance, when the triple piston is ready to be inserted in its cylinder and the side valve applied to its seat, the valve can be turned to the piston as shown in print, in which position the slide valve seat is in full view of the cleaner instead of the reverse, as is the case with lots of triple valves that are cleaned in the ordinary vise. You will note by pulling handle out to clear holding plate, as shown in print, the valve can be swung around so the check case is in an upright position for the cleaner to remove and clean its parts; you will also notice by the location of the stud bolts that all 8-inch triple valves are fastened on one side of the holding plate, and by turning the plate over you can attach the 2-inch and other types of valves. The holding plate is counter-bored on each side to suit the flanges of the triple valves so that it is only necessary to have one stud bolt to hold valve in position.

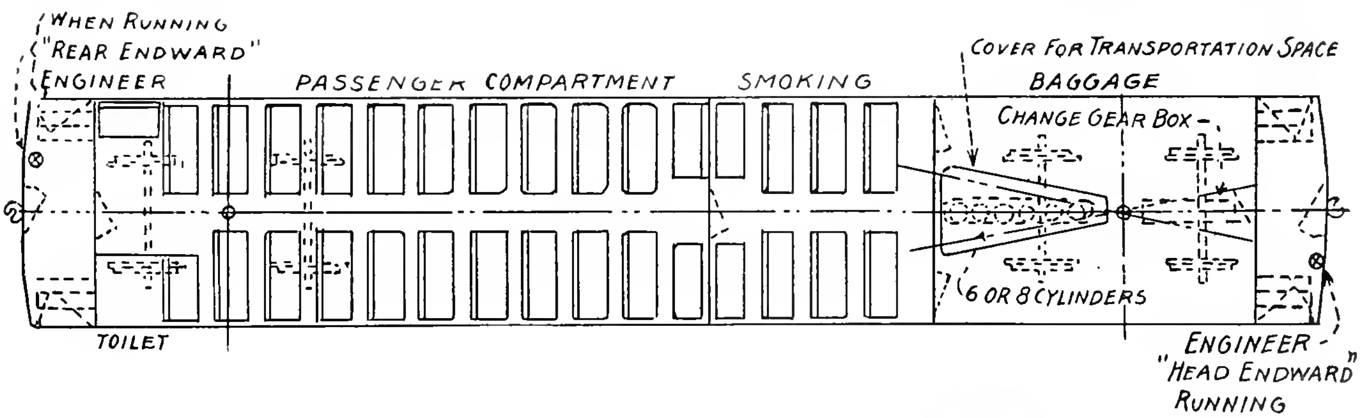
Since having these cleaning stands in use, my percentage of cleaned triple valves has shown quite an improvement, and I feel absolutely sure that when a triple valve is condemned for leaky slide valve and seat that an actual defect really exists and not one due to some foreign substance that was not removed when the valve was cleaned, due to the slide valve seat being out of the full view, if cleaned when the piston and slide valve is applied. I would like to hear from some of your readers along this line with a view tending to improve conditions explained above.

"Assembled" Railway Motor Cars.

By H. Tully, Toledo, Ohio.

The automobile has made such rapid headway in design because the makers have not stopped to make their cars a one man's design. The automobile is an assemblage of standard parts known to be the most highly efficient for the purpose intended and railway motor car builders should pay attention to this lesson the auto makers have learned. The merit of an "assembled" car is shown first by the experience of one of the most prominent companies: when they were installing either of two well known engines in their cars they had a far better power plant in the car than they put in when they went to building their own engines.

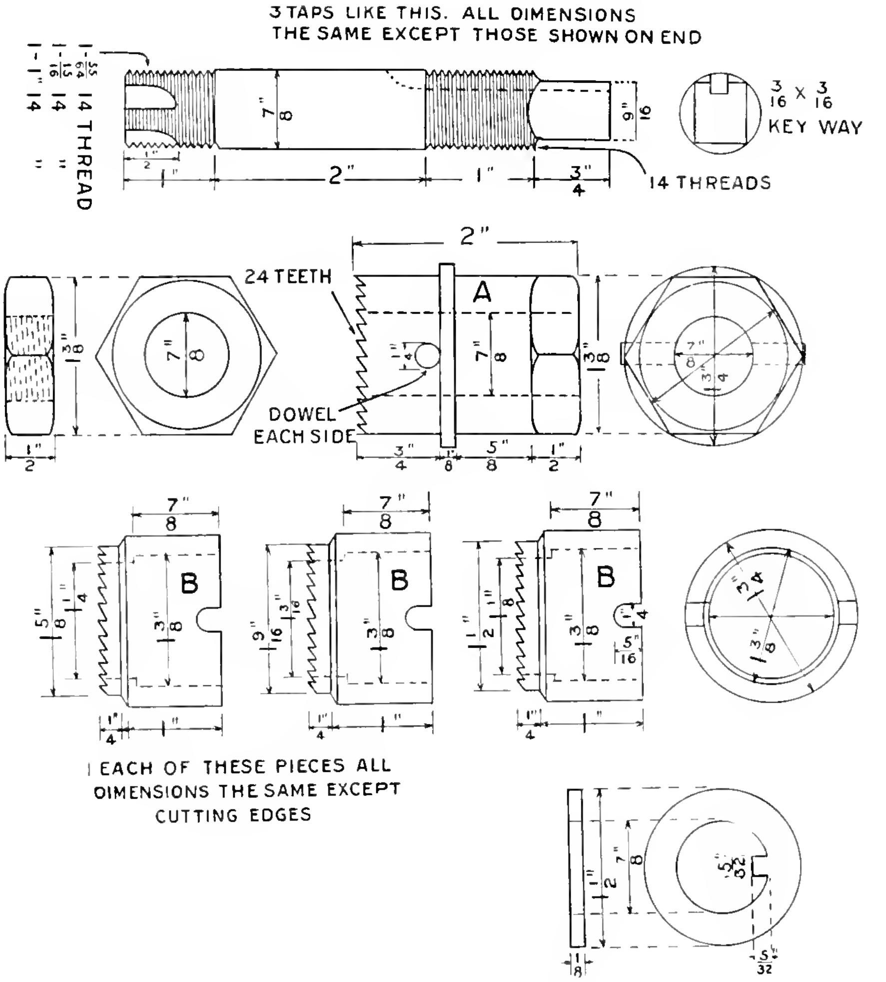
With the above fact in mind: there is shown with this article a plan of an assembled railway motor car; a car that can be built according to any railway's specifications, from parts that have passed the experimental stage and can be depended upon to do the work wanted of them. A coach no longer used for the "best class of travel," is the car a railroad company wants to use in service the motor car is best suited for; with such a car, parts that can be bought of a number of makers and a shop capable of general repairs to locomotives; there is no good reason why equipment for many passenger runs can not be turned out. What is more, such a motor car will not be back to the shop for repairs before a locomotive is that has been turned out the same day.



FLOOR PLAN OF A SECOND-HAND COACH CONNECTED TO A RAILWAY MOTOR CAR.

It may be a question as to it being more safe to use a wooden car alone than in a train; but with gas engine motive power a large way to wear out the hundreds of wooden cars is provided on branches in suburban and divisional runs, with two or three men in the crew instead of five.

The plan shown here asks no experimental trials of an inventor's idea; it is a commercial assemblage that a railroad can specify to suit their requirements—being such, results can be figured out in advance



DETAILS OF FACING TOOL FOR LUBRICATOR PLUGS.

Facing Tool.

By E. L. Bowen, Illinois Central R. R.

The accompanying drawing is a little device for facing the filling plug seats on Nathan "99" and Bull's Eye Lubricator. There are three taps in the set,—one standard size—one, one-sixteenth larger, and one, one-eighth larger. The taps are fluted up from the point one-half inch, and act both as a tap and a guide. In operation the tap is screwed in until the threads are one-eighth below the surface, then piece A is put on over the tap with the washer over it. The nut is then screwed on and the seat faced. One of the pieces marked B, corresponding to the tap used, is then put on piece A and seat cut to one-eighth wide. All pieces are hardened except the nut and washer. This is a very handy device and will pay for itself in a very short time.

The Diesel Locomotive.

By A. Steinmitz, Lausanne, Switzerland.

In 1893, Rudolph Diesel, who had graduated in the engineering classes in the University of Munich, published a pamphlet entitled "A Rational Caloric Motor in Theory and Construction." The news called forth half-amused, half-pitying comments on the part of some; others turned into fierce adversaries and others again applauded the pamphlet with great enthusiasm. Only a few notable engineers and scientists were convinced by scientific reasoning, and they alone stood by Diesel, advocating his idea.

The first engine built in 1893, exploded while being set to work, before it had finished one revolution and nearly killed the inventor. But the very explosion proved to Diesel that the principal idea of the construction was correct. After further very long tests the first working engine was successfully finished in 1897. Many were the constructive improvements which were still needed, nevertheless, the motor was of practical use. Engine works, and among them particularly the Swiss firm of Sulzer Brothers in Winterthur took early steps for its further improvement. After many years of hard work, they brought the Diesel engine to such a high state of perfection that it is a success today, and surpasses all other engines in point of economy.

In the ordinary gas engines the fuel and the air after having been mixed, are brought to explosion by means of a special apparatus, in the Diesel engine the air before being mixed with the fuel, is raised to such a high pressure that the fuel, when entering the working cylinder, will be brought to combustion by the air. As the fuel is introduced gradually, it is also being burnt gradually, so that there is no sudden combustion like an explosion. The result is that the fuel is being burnt up altogether, and the work transacted on the piston is far more powerful than with ordinary explosion motors. Cheap residues of rock-oil or the waste from the oil and coal distillation serve as fuel.

From the year 1900, the Diesel motor as a stationary engine gained ground, and was introduced in all industries, as well as for producing electricity, on the Continent, in England and America. Once the firm of Sulzer Brothers, in Winterthur had brought on the market the so-called two-cycle type of Diesel engine, it was possible to build motors of any required size (up to 3,000 horsepower). In 1905 Sulzer Brothers succeeded in constructing the first reversible two-cycle type motor for the propulsion of vessels and a new era began for this machine. At the end of 1911, 400 vessels had been equipped with the Diesel motor, among them Capt. Amundsen's "Fram," in which he accomplished the successful run to the South Pole.

In applying the Diesel engine to locomotives great difficulties had to be overcome. The principal one, was the placement of the machine within the lines of construction of railway vehicles, other difficulties presented themselves in the balancing of the rotating masses and in the construction of an auxiliary motor to start the engine and drive it while manoeuvring in the stations. The construction of the first Diesel locomotive meant, therefore, two successes. One was the overcoming of the technical difficulties, the other was the creation of a new means of locomotion. The steam locomotive has found a new competitor and though, for the present moment, the steam engine will not be displaced, the Diesel engine will be able to solve many problems much better than the steam engine. This is the case, for instance, when, owing to technical or economical reasons it becomes difficult to procure coal or water.

The first engine of this type has been built for the Prussian Hessian State Rail-

ways and was constructed, as far as the machinery is concerned, in the works of Sulzer Brothers, in Winterthur. Fig. 1 shows an outside view of this type of locomotive, which will be used for express trains. The first tests with this engine took place on the line Winterthur-Romanshorn, as the construction of this track is just of the kind to enable a thorough testing of the engine. At the end of March, 1913, the engine had been transferred to Berlin to undergo still further tests on the line Berlin-Mansfeld.

The engine of the 4-4-4 type has two driving axles and two four wheel bogies; the distance between the two driving axles is 11 feet 8 inches, the wheel base of the bogies measures 7 feet 2 inches, and the distance between the middle of the two bogies is 34 feet 8 inches. The diameter of tread circle of the driving wheels measures 5 feet 9 inches, and that of the uncoupled wheels 3 feet 3 inches. The engine is 54 feet 4 inches in length over all, has weight of 95 tons and attains a speed of 62 miles per hour.

The machinery of the engine consists mainly of a reversible, single-working, two-cycle type motor of 1,000 to 1,200 horsepower and an auxiliary motor, working independently of the driving axle, and producing 1/5 to 1/4 of the force of the large or driving motor. This driving motor has two pairs of coupled cylinders, placed at 90 degrees, with 15-inch bore of cylinder and 21½-inch stroke. The cylinders work a dummy axle, with cranks placed at 180 degrees. This arrangement permits of a perfect balancing of the rotating masses. The auxiliary motor produces compressed air of 50 to 70 atm. and is capable to start and drive the locomotive up to a speed of 6 miles per hour. Once running, the auxiliary motor is used for pumping the fuel from the tank and introducing it in fine sprays in the working cylinders. A number of pumps, which are worked partly by the driving motor and partly by the auxiliary motor, perform different functions, so, one propels the cooling water in the motors, another one does the suction of the cooling water from the piston, a third and a fourth provide for circulation of the cooling water of the working cylinders and inject the fuel, etc. The engine is also fitted with a reservoir for compressed air and with tanks for cooling water and for oil. The waste gas of the motors leaves by a silencer fixed in the roof of the vehicle.

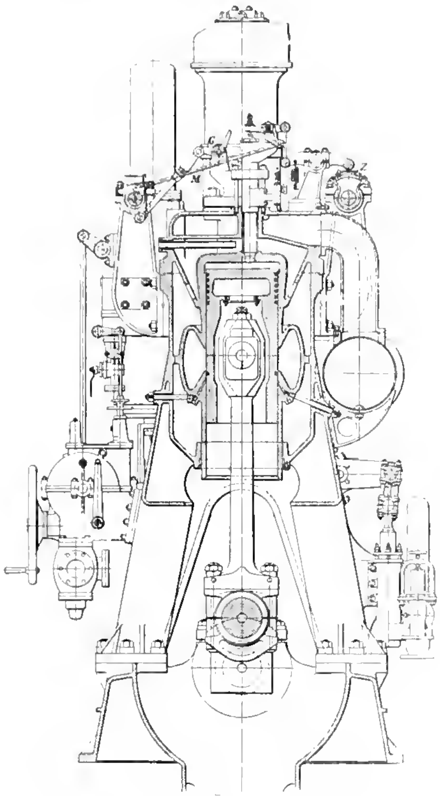


FIG. 2. SECTION VIEW OF DIESEL ENGINE.

In order to protect the machinery, the driver's cab is built over the whole length of the engine and a box has been placed at both ends of the locomotive. In each of these boxes are fixed an apparatus for reversal, levers for working the valves for fuel and for regulating the pumps for fuel, the starting levers, the driver's brake valve, the signaling pipe and the air gauge.

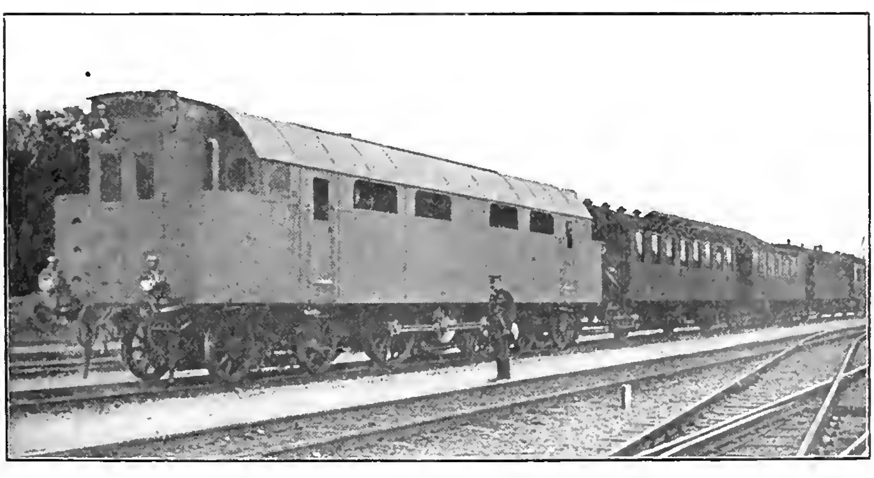


FIG. 1. DIESEL LOCOMOTIVE FOR THE PRUSSIAN-HESSIAN STATE RAILWAYS.

Fig. 2 shows a section view of the Diesel engine as recently manufactured by the Societa Cantieri Officine Savoia, Cornigliano, Lagure, and is a good example of modern Italian engineering. It is a two-cycle type, but as applied to a locomotive in its present state it represents a complicated aggregation of different engines, and the future will show whether it will be possible to simplify the construction. The fact that the first attempts to drive a locomotive with a Diesel motor have shown such good results, is certainly most satisfactory, and one will not fail to look forward with great expectation to the future of the Diesel engine.

The First Railroad in America.

By W. P. Maher, Asheville, N. C.

The pressing need of the country, especially at this time, for additional and enlarged transportation facilities to meet the growing demand occasioned by the phenomenal growth of business in all of its departments and branches, presents itself before the nation as an issue and problem of far-reaching importance. Leaving this living issue, which is now in process of argument and investigation before its proper tribunal, let us delve back into the past and review briefly the origin of railroads in our country. Statistics and data concerning the history of the origin of railroads in the United States should always be a matter of deep interest to the people and especially to our business men.

The first railroad constructed in the United States was the Quincy railroad (1826). It was three miles in length and was built to transport granite from the quarry at Quincy to the Neponset River, close to Boston harbor. This railroad was laid upon granite ties eight feet apart. The cars were drawn by horses and the usual load was ten tons. The schedule of this railroad was three miles an hour.

The Baltimore & Ohio Railroad is credited with being the first railroad constructed in the United States operated as "a steam railroad." This is erroneous. As a matter of fact the first railroad planned and constructed in the United States to have for its motive power steam engines was the Charleston & Hamburg Railroad, in the State of South Carolina, connecting the port of Charleston, S. C., with the town of Hamburg, S. C., located on the Savannah River, opposite Augusta, Ga., the distance between Charleston and Hamburg being 136 miles.

On December 6, 1827, the city council of Charleston called a public meeting of citizens. After varied discussion towards the means and ends of constructing a line of railway to run from Charleston to Hamburg, on December 19 the legislature passed an act, chartering the South Carolina Canal and Railroad Company. The directors realized the great importance of employing an engineer having special ability in construction work. They began to look around for a suitable person and were fortunate enough to engage the services of Horatio Allen. He immediately

proceeded to acquaint himself with the details of affairs as they then existed and in two months he presented a report to the company embodying the cost of transportation by horse power and by locomotive power.

In March, 1830, E. L. Miller, a native of Charleston, who had been present at the opening of the Liverpool & Manchester Railroad and who had studied closely Stephenson's engine on that line, offered to construct a locomotive after his own plan. The offer was accepted and Mr. Miller proceeded to West Point, N. Y., and built the engine at the West Point foundry. The engine arrived at Charleston the latter part of October and was placed on the road November 2. It was named "The Best Friend." It made its trial trips December 14 and 15, 1830. In speed and power it exceeded the most sanguine expectations. It pulled six cars with 50 passengers at the rate of 20 miles per hour and with the empty cars it made from 30 to 35 miles an hour.

The engine was regularly used in carrying materials over the line, and also was used in between times to carry excursion parties. "The Best Friend" was the first American built locomotive and the road upon which it ran was the first American railroad to employ steam locomotive power. The engineer who had the honor to operate it was a native of Charleston named Nicholas W. Darrell. Through the carelessness, or perhaps due more to inexperience, the negro fireman gave the engine an overdose of steam and on June 17, 1831, "The Best Friend" exploded.

About this time the chief engineer, Allen, designed an eight-wheel locomotive which he had constructed at the West Point foundry. This locomotive was put on the line in January, 1832. It was named "South Carolina." It was a very powerful machine, and was the first eight-wheel locomotive in the world.

November 7, 1832, the road was completed and opened for traffic between Charleston and Branchville, a distance of 61 miles. On November 2, 1833, the entire line from Charleston to Hamburg was finished and begun its operations of common carrier. It was the longest line of railroad in the world to be operated solely by steam locomotive power.

In summarizing some of the distinctive features of priority that the Charleston & Hamburg Railroad can claim over its competitors, it may be mentioned: It was the first railroad constructed in the United States, built and planned to be operated by steam locomotive power. Constructing and operating on its road the first American built locomotive. Having for its first chief engineer the man who ran the first locomotive in America.

We learn that in February, 1835, the splendid locomotive "Edgefield" was making its regular schedule, pulling five passenger cars the distance of 136 miles in seven hours and 20 minutes; that the railroad owned 12 engines, 20 passenger cars and 135 freight cars, and that regular schedules were operated—both freight and passenger, and that depots had been built along the line about 10 to 15 miles apart.

This is, in brief, a historical summary of the first steam railroad built in the United States. This line is now a part of the Southern Railway system.

Combustion in Locomotive Fireboxes.

By Angus Sinclair.

ENERGY IN ONE POUND OF COAL.

The heat, and therefore the potential, mechanical energy contained in one pound of good coal is enormous when burned by combination with pure oxygen, but under the conditions of ordinary firebox combustion the available heat of the coal is greatly diminished. Most people, if asked which contains the greater amount of potential energy, a pound of gunpowder or a pound of coal, would think the question absurd, and assert that the gunpowder was certainly by far the most powerful. Yet a belief of that kind is a popular error.

The chemical combination of one pound of carbon with its equivalent of oxygen liberates about 14,500 units of heat. A heat unit, or the quantity of heat required to raise the temperature of one pound of water, one degree Fahrenheit is, when applied to mechanical work, equal to raising 772 pounds one foot high. So 14,500 x 772 is equal to 11,194,000 foot-pounds, and represents a force of over 5½ horsepower.

POWER OF COAL AND OF GUNPOWDER COMPARED.

One pound of charcoal combined with saltpeter to form gunpowder would produce only about one-tenth the heat developed by the same weight burned in free oxygen. To quote Tyndall on the subject: Saltpeter, or nitrate of potash is formed by the combination of nitrogen, potassium and oxygen, one consequence of that combination being the generation of heat. To unlock the atomic embrace of the nitrogen, potassium and oxygen, an amount of heat must be expended equal to that generated by their union, and by this exact amount the heat produced by combustion is free oxygen.

CARELESSNESS AND IGNORANCE DIMINISH THE PRACTICAL VALUE OF COAL.

While this illustration may be useful to impress upon the mind the great power value of a pound of coal, it must be admitted that coal as used ordinarily in our locomotive fireboxes, falls very far short of its theoretical efficiency. Various circumstances, many of them unavoidable, contribute to curtail the useful heat derived from coal, but it is undeniable that carelessness and ignorance are responsible for many of the losses that bring reproach upon the locomotive as a generator of power from coal.

UNAVOIDABLE CAUSES OF WASTE OF HEAT.

The discrepancy between the theoretical and the actual value of a pound of coal seems alarming when the calculation is first made. It seems a most extraordinarily imperfect way of using fuel when it takes from 2 pounds of coal per hour in the best steam engines up to about 10 pounds with inferior engines to produce one horsepower per hour, when there is 5½ horsepower in a single pound of charcoal properly burned. A large percentage of the loss goes off in the exhaust steam and is not attributable to faults of the furnace or mismanagement of fire. Other losses are inseparable from the system of transmitting the heat of coal into mechanical work through the medium of steam, for the gases of combustion must be passed into the atmosphere at a higher temperature than that of the water inside the boiler.

GREATEST POSSIBLE WEIGHT OF WATER EVAPORATED PER POUND OF COAL.

When every heat unit in a pound of carbon is utilized and transferred to the water, one pound of fuel is capable of evaporating about 15 pounds of water, and one pound of carburetted hydrogen evaporates about 27 pounds of water. These figures give a little more than the total heat contained in the best coal, and they ought to be remembered by capitalists and others who are frequently requested to take stock in companies to build patent boilers represented as being capable of evaporating 40 or 50 pounds of water to the pound of coal.

AIR REQUIRED FOR COMBUSTION.

The quantity of heat per pound of coal available for steam-making is considerably below the figures of maximum evaporative power, and depends to a great extent upon the means taken to prevent waste. Each pound of coal burned in a firebox has to heat all the volume of air that passes in to supply the oxygen to sustain combustion, and no small proportion of the heat units is absorbed in this duty before any heat can be utilized for steam-making, and is carried away to the stack, owing to the profusion of the supply. Water is not the only kind of a flood that tends to useless waste.

Each atom or 12 parts by weight of carbon in the coal combines with 2 atoms or 32 parts by weight of oxygen to form carbonic acid for the highest form of combustion, or to put the figures in a more intelligible way, 1 pound of carbon requires 2⅔ pounds of oxygen for its perfect combustion. As 4.35 pounds of air are required to furnish 1 pound of oxygen, we have 4.35 x 2⅔ = 11.57 pounds

as the quantity of air that must pass into the firebox for each pound of carbon consumed, even were the whole of the oxygen utilized in furnace combustion, which is by no means the case. To obtain fairly complete combustion, the fire must be saturated with air, so that sufficient oxygen shall reach the carbon and hydrogen to permit of chemical union. With the most favorable conditions of combustion in locomotive fireboxes, with well arranged draft appliances and good firing, it takes about 20 pounds of air per pound of coal consumed to supply the oxygen required. Coal rich in hydrocarbons requires a little more air than anthracite coal, because each pound of hydrogen requires 8 pounds of oxygen and consequently 4.35 x 8 = 34.80 pounds of air to the pound of hydrogen.

A pound of air at average atmospheric temperature and pressure occupies about 13 cubic feet, so our locomotives when well managed have to pass about 260 cubic feet of cold air through the firebox for every pound of coal burned. An ordinary passenger locomotive burns about 50 pounds of coal per minute, so that about 50 x 260 = 13,000 cubic feet of air have to be provided to the fire during that time.

To illustrate the necessity for means being taken to supply as nearly as possible the required quantity of air to the firebox, a few more calculations must be given. As calculating the heat generated by a mixture of carbon and hydrogen combining with oxygen is more complex than the calculation for carbon alone, and is likely to confuse the reader without adding materially to the knowledge of those who would comprehend the figures, I shall confine myself to working out an estimate of the heat available for steam making, obtained from each pound of carbon in a locomotive firebox. The figures will apply more correctly to an engine burning anthracite coal than to one burning bituminous coal, but the principles involved apply to both.

SPECIFIC HEAT OF THE GASES.

As oxygen combines with the carbon of the coal, the extent of the rise of firebox temperature that ensues will depend upon the weight of the combining gases and the quantity of heat required to raise the temperature of 1 pound by 1 degree Fahrenheit, which quantity is termed the specific heat of the gas. Most readers will understand that gases have different degrees of specific heat, just as liquids and solids have. The difference between the specific heat of different gases is about as great as that between water and iron, where a quantity of heat sufficient to elevate the temperature of one pound of the former 1 degree is sufficient to raise the temperature of the latter about eight times as high.

FIREBOX TEMPERATURE WITH DIFFERENT SUPPLIES OF AIR.

Taking 1 pound of carbon generating 14,500 heat units, and requiring 20 pounds of air for combustion, supposing complete combustion to take place, there are 21 pounds of mixed gases to be heated. Of these there are 3⅔ pounds of carbonic acid gas, with a specific heat of .217, 9⅓ pounds of nitrogen, with a specific heat of .244, and 8 pounds of atmospheric air, with a specific heat of .267. We have then 3.7 x .217 — 9.33 x .244 — 8 x .267 = 5.212 units, the heat required to raise the temperature of the whole mixture by 1 degree Fahr., and 14,500 ÷ 5,212 = 2,780 degrees Fahr. is the elevation of temperature. The advantage of restraining the admission of air to the lowest possible point consistent with the full supply of oxygen will be understood when it is stated that, with the admission of 12 pounds of air, the elevation of temperature would be 4,700 degrees Fahr. were it possible to supply sufficient oxygen for complete combustion from that quantity of air. There would really be no more heat generated, but it would be spread through a smaller volume, would tend to keep the firebox temperature higher, and as the difference between the temperature of the water to be heated inside the boiler and the heating gases would be greater, the probability would be that more of the heat would be abstracted by the water.

HEAT AVAILABLE FOR STEAM-MAKING.

All the heat in the firebox liberated by the union of carbon and oxygen, and calculated in the last paragraph, is not, however, available for steam-making. When a boiler is carrying a steam pressure of 140 pounds, the temperature inside the boiler is 360 degrees Fahr. It is manifest that the gases of combustion which maintain the temperature of the boiler by imparting heat through the firebox sheets and tubes, must pass out through the smokebox at a higher temperature than that of the water inside the boiler. Owing to the high rate of speed at which the gases are drawn through the tubes of ordinary American locomotives, the smokebox temperature is generally very high, and 800 degrees Fahr. may be taken as a low average. Taking the temperature of the gases on entering the firebox as 50 degrees Fahr., we have 750 degrees of heat that has been abstracted from the total heat of the furnace and passed out through the smoke stack. We found that it took 5,212 units of heat to raise the products of combustion 1 degree, and as 750 degrees have escaped into the atmosphere, we have 750 x 5.212 = 3,909 heat units wasted, leaving 14,500 — 3,909 = 10,591 heat units as being available for steam-making. Thus it will be seen that the losses are very great.

LOSSES DUE TO EXCESSIVE AIR SUPPLY.

Several indirect losses result from the practice of passing more air through the fire than is needed to effect complete combustion. The lower temperature maintained in the firebox leads to serious waste of heat from a portion of the gases passing away without being ignited, and the large volume of the gases that has to pass through the tubes induces a high velocity of flow that permits insufficient time for the heat to be absorbed while passing the heating surfaces. There is also a direct loss where a large volume of air is employed, even when the exhausted gases are at the same temperature as the escaping gases, over a case where a curtailed volume of air is supplied to the fire under proper conditions. Let us take two examples for calculation. When 12 pounds of air admitted to consume 1 pound of coal, 13 pounds of gases pass into the stack at, say, 800 degrees, 750 degrees representing lost heat. In this case 3.076 units would be the heat required to raise the temperature of the products of combustion 1 degree. So we have 3.076 x 750 = 2,307, the heat units lost, and this deducted from 14,500 leaves 12,193 units available for generating steam. On the other hand, suppose 25 pounds of air are supplied for each pound of coal burned, which is quite a common supply among our small nozzle locomotives, 26 pounds of gases will be discharged into the stack at a temperature also of 800 degrees, 750 degrees to be lost. In this case it requires 6.5 units to raise the gases of combustion 1 degree. So we have 6.5 x 750 = 4,875 heat units lost for each pound of coal burned, or 2,568 heat units more than when 12 pounds of air were admitted to the fire.

In practice, 12 pounds of air per pound of coal would not be an economical way of maintaining combustion, but the illustration may be useful.

I have entered into these details at considerable length because I am aware that serious misapprehension prevails in many quarters respecting the quantity of air needed for combustion in locomotive fireboxes. Many mechanical men act on the assumption that too much air cannot be supplied to the fire so long as it is put in through the grate bars. When the truth becomes established and generally recognized that the supply of air ought to be regulated, even through the grates, convenient and proper means will be provided to regulate that supply, a matter which receives extremely little consideration at present.

Coke Burning.

The Elgin, Joliet & Eastern Railway people contemplate burning coke in their locomotives in places where the smoke from soft coal is considered a nuisance.

General Foremen's Department

Shoes and Wedges.

By A. W. Vestal,
Missouri Pacific Railway, Sedalia, Mo.

After reading the admirable article on shoes and wedges by Mr. Chamberlin in your March number, it occurred to me that it was a remarkable fact, that methods of doing work which are considered correct in some shops will not be tolerated at all in others. Of course it is self-evident that any line of procedure will be correct so long as it brings correct results, yet methods that may be correct in principle may not be best in all cases because of other things that must be considered at the same time.

Initial conditions are not always the same, and the element of time plays a very important part in our modern high-speed shops.

Two men of equal ability may each have very decided opinions of their own, which reminds me of the Irishman, who, being asked which he considered correct pronunciation, "niether" or "neither," replied emphatically that it was "nather," which only goes to show that most men have very decided opinions of their own regardless of what they may have learned from the experience of others.

Mr. Chamberlin speaks of getting the square line by means of the "fish-tail tram." Now, I have no means of knowing whether Mr. Chamberlin is one of the "good old-timers" or a member of the more modern school, but in ten years' experience in a number of shops I have never known one in which the fish-tail tram was allowed in finding the square line except by special authority and in exceptional cases when the square line had to be located without removing the pistons from the cylinders.

Now, I think the majority of men who are familiar with this class of work will agree that a "square line" may be defined as a line across the frames, at right angles to the center line of motion, *i. e.*, the center line of cylinders, and if the center lines of the cylinders are parallel to each other and parallel to both frames, the use of the fish-tail tram will give correct results, but there is not one case out of a dozen when these conditions will prevail, especially where one or both frames have been taken down or a new cylinder put on. It has always seemed to me that the best way to locate the square line is to line the cylinders—start from the beginning, as it were, and work back. The lines should be set very accurately in the cylinders and carried to the rear of the engine. After the lines are set, by measuring between them, front and back, you can tell whether the cylinders are parallel, and by measuring between each line and frame, front and back, you can see at once whether the frames are parallel with the cylinders. If they are not, they may nearly always be moved at the back end enough to make them come right.

In locating the square line, place a straight-edge across the main jaws, blocking it up almost to the line on each side and clamp it firmly to the jaws. It is

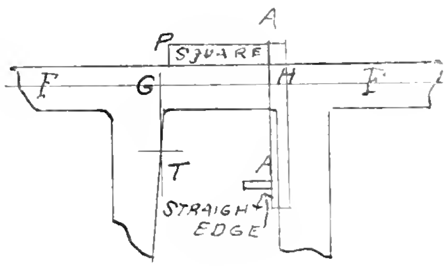


FIG. 1.

understood that the binders are all up in place before beginning the work.

Now, by placing a square against the straight-edge and bringing one leg up to the line it may be seen at a glance whether the straight-edge is at right angles to the lines. If it is not, by placing liners between straight-edge, and join on the side showing the largest angle, it may be brought to exact position, and if the lines are not parallel, divide the difference as closely as possible.

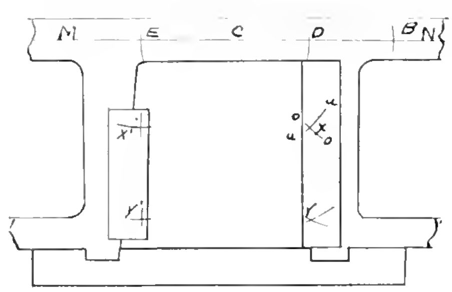


FIG. 2.

Now place one leg of the square on top of frame with the other extending down in front of the straight-edge, as shown in Fig. I, and draw it back until it touches. Scribe line AA. Repeat the operation on the other frame. These are the square lines.

To locate the square centers, lay off the length of the wedge from the binder on the main wedge jaw as H T, T being the intersection of lines representing top of wedge and face of jaw. Scribe the line T P through point T and at right angles to top of frame. Now scribe the lines F F on all the jaws, parallel to top of frame. Prick punch the intersections G and H (It is only necessary to locate point G on one frame), and with a pair of small trams locate the exact center, B, between them. Take the distance, B H, and lay it off from H on the other side, and you have the square centers located.

Now, in regards to Mr. Chamberlin's method of laying off shoes and wedges, it will undoubtedly give correct results, but I am afraid it would be too slow in the majority of our modern railroad shops.

Modern shop practice not only demands accurate work, but the cry for speed is always with us, and every short cut must receive due consideration. Laying off shoes and wedges by the method I will attempt to describe is not exactly new. I don't know when or where it originated, but for fast, accurate work it certainly fills the bill. With the square centers located and the shoes and wedges all up in place, an 8-wheel engine may be done easily in two hours, which I consider fast enough for anybody. The first thing to do is to lay off all the rod lengths with a long tram, starting from the square center at the main jaws. Now get the size of the boxes, and there is no more excuse for boring a driving box out of center than there is in making a misfit on a driving axle. It is simply the result of carelessness or incompetence. Of course, if there is any doubt of their being central, it is best to try them. It has always seemed to me that a machinist ought to have full confidence in the accuracy of his own work and a reasonable amount of confidence in the work of others.

I can remember working in a shop, at one time, where all shoes and wedges after being planed, were filed and spotted to the jaws and boxes and then the binders, shoes and wedges, and the boxes were all put up in place, the wedges adjusted, the boxes centered and trammed to see if they were correct before wheeling the engine, causing an enormous amount of work without improving on the job in any way and all because of a lack of confidence. After getting the size of all boxes add 2 inches to the size of each box and divide by 2; the extra inch will make the shoes and wedges easier to lay off, easier to set up and plane and also leaves a proof mark. Set the small trams at half the box size x 1 inch, as found, and lay each size off in its proper place from the box center, front and back, as C D and C E, Fig. 2.

Now over the main front jaw on each frame, using D as a center, lay off D B

equal to D C. Put all the shoes and wedges up in place, blocking them finally against the jaws, and also block the wedges up off the binders.

Now, if you are using old shoes and wedges which have to be lined, put them all up and place on leg of a square on top of frame; bring the other leg up against face of shoe or wedge and measure over from point D, etc., to square. The amount it lacks of being 1 inch will be the thickness of liners required. Now set the small trams to any convenient length and C as a center scribe the arc A A, and with the same length and with B as center scribe arc O O. Prick punch the intersection of the two arcs at X and verify the correctness of point X very carefully.

Without moving trams, repeat the operation on the other main shoe, and then with the proper radius and same centers locate point Y on each shoe in the same manner. Now it may be seen that the point D on the frame has been transferred to the shoe by erecting a perpendicular from the point D on the base line M N, that is top of frame, by the simplest and most accurate way in which it could be done and how also to determine the verticle location of points X and Y at the same time. The wedge being shorter than the shoe it is necessary to locate X and Y on the shoe so they may be transferred to the wedge.

As these points are necessary in setting up the shoes and wedges on the planer some points located on line connecting X and Y must be transferred to the inside of the shoe. This may be done by placing a straight-edge across the faces of the shoes, but by far the easiest and quickest way is to use a transfer tram shaped as shown in Fig. 3. Extend the end L L over top of frame, set point at C, and with other end of tram scribe arc on inside of shoe. Catch the point B as a center and scribe the other arc. The point of intersection of the two arcs will be the point desired. It may be noticed that by using this tram it makes no difference whether the main boxes are the same size or bored out of center or not, if the correct size of each box has been laid out on the frame the point located on inside of shoe is certain to be correct.

Set the small trams to length D X and lay it off on all shoes as at T and T. Fig. 4. Do the same with the length D Y. The vertical location of the point X on inside of the shoes and wedges can be obtained by using a pair of maphrodites from top of binders.

Now set the long trams to the length D F, Fig. 4, and take notice here that if the boxes are standard size, the length D F will equal the rod length C C, and not otherwise. With X as center and length D F scribe arcs R R, as shown in Fig. 4, top and bottom, also on inside of shoe and other side of engine. Repeat this on all shoes front and back of main and always remember it is the box size marks you want and not the rod length. Now set the small trams to each box size as D E, and lay off the proper box size on each wedge as x x[1] all around, inside and out, and you are done, although it is wise to circle all marks on shoes and wedges so they may be identified, and stencil them all before taking down.

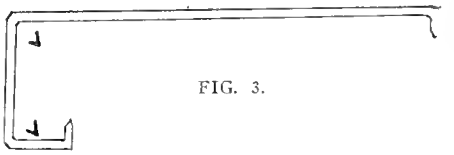


FIG. 3.

Many times in laying off new shoes and wedges some of them won't "true up" apparently, and to line a new shoe or wedge makes the average machinist feel like "cussin'" the company. By using a little "headwork" this may nearly always be overcome by shifting them around or setting the centers ahead or back. A glance at Fig. 4 will show that all that is necessary in order to set all centers ahead or back the same amount is to set the points B and C ahead or back the same amount, and all the others will take care of themselves.

All young mechanics should realize that it takes more skill to lay off shoes and wedges than to dig post holes or stake out a flower bed, and should learn to work carefully. Be sure your trams stay set where you put them; don't use a nail for a prick punch, a two-foot rule for a scale, and don't get rattled.

One of the greatest sources of trouble for some men in laying off shoes and wedges is in getting "mixed up," although there is little cause for confusion. In the "good old days" shoes and wedges and valve setting were looked upon by many as a sort of mystery, but those times have passed away. Knowledge comes easier nowadays, and the young mechanic don't have to rely on what some older man is willing to tell him, but by a little careful reading can dig it out for himself. And if an error is ever committed it should be a lesson that he should always remember.

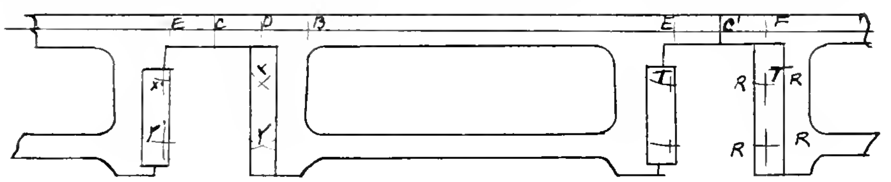


FIG. 4.

Utilizing Lignite.

For years the immense deposits of lignite in various parts of the United States were regarded as worthless, so far as fuel value was concerned, but now numerous concerns are converting the lignite into briquettes which have more heat value than ordinary coal. This change can be made for about $1.50 per ton, an expense that is not excessive for good fuel which has high weather resisting power. The most expensive thing about briquette making is the binder, which consists of some sticky substance such as tar, but some lignites are suitable for briquettes without any binder.

The subject is treated at greater length on page 123, of the present issue of RAILWAY AND LOCOMOTIVE ENGINEERING.

Larger Cylinders for Locomotives.

The test department of the Pennsylvania Railroad has been carrying on experiments with superheater locomotives, as a result of which they have determined that when a locomotive is converted from saturated to superheated steam, her cylinders should be enlarged. The results obtained show that, to secure maximum economy, the cylinders should be enlarged to such an extent that the maximum indicated horse-power will be developed at a cut-off not exceeding 30 per cent.

Fourteen-Mile Tunnel.

The Canadian Pacific has been granted permission by the government to bore a fourteen-mile tunnel under a mountain a mile high, near Rogers pass, in the Selkirk range. It is to shorten the route to the Pacific and to lessen the danger from snow slides that the great bore is to be built at a cost of many millions of dollars.

Finishing Canadian Northern.

The completion of the Canadian Northern as a transcontinental railway from tidewater, at Quebec, to the Pacific coast, will not be later than September 1, according to President William MacKenzie. Requirements for equipment provide for fifteen passenger trains each day, east and west.

How Rails May Slip.

Friction of the drivers of a locomotive causes rails to slip unless anchored, but the direction of the slip is the opposite to that which might be supposed. The rails creep forward under the pressure of the train, much as a paper will when pushed by the hand.

To make a hack-saw cut metal more smoothly and rapidly, with less noise, and last longer, use thereon as lubricant a mixture of two parts of tallow and one of good black-lead graphite.

Catechism of Railroad Operation

NEW SERIES.

Second Year's Examination.

(*Continued from page 91, March, 1914.*)

Q. 42.—How often should the lubricator be blown out?

A.—This depends on condition of oil used, as regards sediment. But it should be blown out at least once in a week.

Q. 43.—How long before leaving a terminal should feed valves be opened?

A.—About ten minutes, not over fifteen minutes before leaving.

Q. 44.—How many drops per minute should be fed?

A.—About three drops per minute to each cylinder.

Q. 45.—Describe the principle and operation of a sight feed lubricator?

A.—Steam is admitted to the condensing chamber, and condenses to a level with the upper ends of the equalizing tubes that lead to the feed arms and maintain an equalization of pressures there with the steam pressure in condensing chamber. The water valve allows the water to pass from condensing to oil well or cup, and the oil being lighter than the water is raised to the top of oil cup above the ends of oil tubes which lead to the lower feed arms, and when the feed valves are opened the oil is forced up into the sight feed glasses by the weight of the head of water in condensing chamber and oil cup. In the sight feed glasses the oil rises to the top of the wat-r in the upper feed arms (this water being level with the openings in the choke plugs) and then the oil flows through the choke plugs openings to the oil pipe and down to the cylinders through force of gravity. Therefore the lubricator operates through condensation, equalization, water pressure and force of gravity.

Q. 46.—Does a cold draft affect the working of a lubricator? Why?

A.—Yes. Because it cools the oil so it will not flow freely and affects the equalization.

Q. 47.—Name the different causes for irregularity in lubricator feeding?

A.—Steam pipe leading to condensing chamber too small, or steam valve only partially opened; equalizing tubes stopped up or too small; choke plug openings worn too large, or the choke plug loose.

Q. 48.—When and in what order should you close the steam and water valves on a lubricator?

A.—At the completion of a trip, or when necessary to fill lubricator, the water valve should be closed first and then the steam valve may be closed. At the beginning of a trip or after filling lubricator, the steam valve should be opened first and then the water valve may be opened.

Q. 49.—What will result from filling a lubricator with cold oil?

A.—Oil will be wasted and the lubricator will be strained, because the cold oil will expand and exert a great pressure on the walls of the oil reservoir, and when the water valve is opened some of the oil will be forced back into the condenser, and in some types of lubricators oil will be forced into the boiler.

Q. 50.—If the sight feed is stopped up, how would you clean them out on the different styles of lubricators?

A.—Close all feed valves but the one affected, open check valve in top feed arm, then open the drain plug and steam from the equalizing tube will blow out the dirt and sediment from the glass and feed tip. On some of the modern types drain cocks are provided in lower feed arm, and a plug valve controls the opening from top feed arm to feed glass, to be used when necessary to blow out.

Q. 51.—How would you clean out chokes on different styles lubricators in use on this road?

A.—On most lubricators the chokes can be cleaned by closing the main steam valve and draining a little water out of oil cup and condensing chamber, then open engine throttle and the steam coming up through oil pipe will blow out the obstruction. Another way is to close the main steam valve, open the check valve in top feed arm, open sight feed drain, then open throttle and blow dirt into feed glass. On others it is necessary to disconnect the oil pipe and clean them by hand.

Q. 52.—Which is the better practice, to close the feed valves or the water valves while waiting on a siding?

A.—It is better to close the feed valves.

Q. 53.—How can you tell when the equalizing tubes become stopped up?

A.—With equalizing tubes partly stopped up, the oil will run in streams from the feeds when the throttle is eased off, and if they are entirely stopped up, the oil will squirt from the feed tips.

Air Brake Questions Answered. 2nd Year's.

Q. 1.—Name the operating parts of the 9½ in. pump? the 11 in. pump?

A.—Steam piston and air piston connected to same piston rod, reversing plate, reversing stem, reversing valve, main steam valve, differential piston, receiving valves and discharge valve. The parts of the 11 in. pump are the same as those of the 9½ in. pump.

Q. 2.—Explain the operation of the air end of pump on the up-stroke? the down stroke?

A.—When the air piston starts on the up stroke the air that is in the upper end of the air cylinder is compressed and forced out by the discharge valve and through the discharge pipe into the main reservoir, and in the lower end of the air cylinder there is being formed a vacuum which causes the atmospheric pressure to raise the receiving valve from its seat and the air will flow into the cylinder until the piston completes its stroke, filling it full of air at atmospheric pressure, then the receiving valve drops to its seat of its own weight. The piston starts on its down stroke and the air present in the lower end of the air cylinder is compressed and forces the lower discharge valve from its seat and passes through discharge pipe into the main reservoir, and a vacuum is formed in the upper end of the air cylinder that causes the air entering receiving strainer at atmospheric pressure to raise the upper receiving valve from its seat, and air flows into the upper end of the air cylinder until at the completion of stroke the cylinder is filled with air at atmospheric pressure and the receiving valve drops to its seat of its own weight.

Q. 3.—Explain the operation of the steam valve gear of the 9½ in. pump on both stokes.

A.—The first stroke of the pump is generally the up stroke; all parts being at the lower end of stroke, the reversing valve will be in position to connect chamber back of large head to differential piston with the exhaust and the steam in the main valve chamber moves the differential piston to the right, and it moves the main steam valve with it to a position where the admission port to the lower end of the steam cylinder is opened and live steam is flowing into the cylinder and moving the piston on the up stroke. The hollow or exhaust cavity in the main steam valve is connecting the admission port to the upper end of the steam cylinder with the exhaust and any pressure present in the upper end of the cylinder to escape to the atmosphere. As the piston nears the completion of the up stroke, the shoulder on reversing stem engages the reversing plate on piston head and is moved upward, moving the reversing valve up to a position where the live

steam is admitted to chamber back of the large head of the differential piston, and pressures are equalized on each side of large head to differential piston neutralizing it, and the steam pressure on small head of differential piston moves the piston to the left and the main steam valve is moved with it to a position where the admission port to the upper end of the steam cylinder is opened and live steam enters the cylinder, pushing the piston on its downward stroke. At the same time the admission port to the lower end of the cylinder is placed into communication with the exhaust through the exhaust cavity in main steam valve, and the steam used in the up stroke is exhausted to the atmosphere. As the piston completes the down stroke, the reversing plate engages the button on the lower end of the reversing rod and pulls it and the reversing valve down to a position where the steam will be exhausted from back of the differential piston and the parts move to position for the up stroke.

Q. 4.—How many strokes (single) per minute should pumps run to give best results?

A.—120 strokes per minute; never more than 140 at any time.

Q. 5.—What should govern speed of pumps on heavy grades?

A.—The length of train and the amount of train line leaks.

Q. 6.—What is the duty of the pump governor, and how is it adjusted?

A.—To control the main reservoir pressure by stopping the pump when the pressure reaches the maximum. It is adjusted with the regulating spring and regulating nut.

Q. 7.—Does the governor control the speed of the pump? How is the speed controlled?

A.—No. The speed is controlled by the throttle valve regulating the amount of steam admitted to the pump.

Questions Answered

Percentage of Piston and Valve Strokes.

A. D. Kenora, Ontario, asks:—(1) What percentage of the stroke of a piston does a valve cut-off? (2) also, at what percentage of stroke do we have a full open port, with the engine working a full gear? I may add that I have been informed that British locomotives cut-off at 75 per cent. A. (1) It depends entirely on what position or notch the reverse lever latch is placed. Supposing that the piston stroke is 24 inches, an economical use of steam would be to place the lever at a point where the valve would shut off the steam when the piston had moved about one-fourth of its stroke, or about 6 inches, the remaining 18 inches of the piston stroke would be impelled by the expansion of the steam already in the cylinder. If this is not enough to keep the train at the desired speed, the stroke or period of time during which the valve is open could be increased by moving the lever further away from the center of the quadrant. There is, therefore, a wide range in the matter of the point of cut-off, ranging probably from 6 inches to 20 inches. (2) The percentage of full open port with the engine in full gear, that is, with the lever on the extreme forward or backward notch, depends on the size of the steam-port, the amount of valve travel, and the amount of lap and lead, but generally speaking the port could not remain fully open for more than 60 per cent. of the stroke.

In regard to British locomotives, there is no difference of any kind in the manipulation of the valve gear or in the relation of the stroke of the valve to the stroke of the position. All aim at the economical use of steam, and at the same time an effectual meeting of the requirements of the service.

Point of Exhaust and Link Radius.

C. V. M., Wilmington, Del., asks:—(1) Does an engine exhaust when the crank pin is at or nearly at the top or bottom centres? (2) If an engine exhausts about these points, and the engine had negative lead in full gear, where would it get its power if it stopped on the exact dead centre? (3) Has the size of driving wheels on an engine anything whatever to do with the radius of the links? A. (1) No. The exhaust does not occur until the piston stroke is nearly completed. An opening of the exhaust at or near the points referred to would occasion a loss of steam and a great diminution in the power of the engine. (2) No matter at what exact point the exhaust occurs the engine has no power when the crank is at the dead centre, other than that acquired power known as momentum. In the case of a single engine, as in most stationary engines, the cranks are carried over the dead centres by the acquired momentum of the fly wheel, which, properly speaking, is stored energy. In the case of the locomotive in addition to the momentum acquired by the weight of the moving mass, it will be noted that when the crank of an engine is on either of the dead centres, the crank on the other engine, at the other side of the locomotive, is either on the top or bottom centres, and the piston is consequently in a position to receive the full impact of the steam flowing in from the valve, which is fully open or nearly so. Hence one crank being on the dead centre is no impediment to the starting of a locomotive equipped with two or more engines. (3) The size of the driving wheels has little or no relation to the radius of the links. The links derive their radius, or line of curvature, from the distance from the centre of the axle, to which the eccentrics are attached, to the centre of the links in the case of the Stephenson valve gear, and from the length of the radius rod in the case of the Walschaerts gearing.

Light Firing.

W. G. L., New York, N. Y., writes:—(1) I have frequently had the job of firing a 2-8-2 locomotive running light, and have great difficulty in keeping down the steam pressure and preventing blowing off at the safety valves. A method which I have used with moderate success is to cover the fire heavily with green coal and open both doors 2 inches. The heavy firing part does not seem to do much good. What would you advise? (2) Do you consider it harmful to open both doors an inch or two when running along with a short cut-off and fairly light exhaust? Some of these 2-8-2 type of locomotives steam so freely that this is necessary to prevent blowing off, even with as many as 60 empties and the injector working. What is the temperature of the back flue sheet with a steam pressure of 200 pounds? I imagine it cannot be over 500 degrees, and cold air coming in contact is, I think, too often the reason assigned for leaky flues, as the air before reaching the flue sheet must be raised to about the same heat as the flues. A. (1) We would advise light firing. The keeping of the fire doors slightly open has the effect of keeping down the temperature, and is of no serious injury. It is the shutting and opening of the doors at short intervals that causes expansion and contraction and is very pernicious. (2) At 200 pounds pressure the temperature of the water around the back flue sheet would be about 380 degrees and the average temperature in the fire box about the same locality would be about 850 degrees. The temperature in the flues decreases to less than 500 degrees before reaching the front flue sheet, varying according to the length of the flue.

Vacuum in Cylinder and Valve Chambers.

W. W. B., Crewe, Va., writes: Please advise as to whether it would be an advantage or a disadvantage if a vacuum was created in the cylinders and valve chambers of a locomotive while drifting. A. It is a disadvantage and to avoid it a number of devices have been invented to admit the free passage of air when the throttle is closed. The chief trouble in case of a partial vacuum arising is the tendency to draw ashes from the smoke-box into the steam chamber and cylinders This defect is overcome by the use of relief valves attached to the steam chests.

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American and British Railroads.

The appointment of Mr. Henry Worth Thornton, formerly general superintendent of the Long Island Railroad and recently appointed to the position of general manager of the Great Eastern Railroad of England, has given rise to considerable discussion both in America and Great Britain in regard to the manner in which railroads are managed in both countries. The London *Statist*, an eminent authority on economic questions states that it is the difference between science on the one hand and rule-of-thumb on the other, and it gives unqualified precedence to America for the complete possession of the science.

A statement of this kind from such a source has undoubtedly far more weight with the British people than if it came from America. We have long been aware of our great and growing superiority of the management of railroads. The spirit of enterprise and invention is encouraged in the western world to a degree beyond the dreams of the fossilized promoters of the old world, whose somnolent mentality seems almost incapable of entertaining any other idea than that of letting things remain as they are. As the *Statist* states it, the criticisms and comments of a great many persons who for many years have desired to assist their country and their countrymen to place the railway industry of Great Britain in a condition of the highest efficiency have for the most part fallen on deaf ears. Their efforts to induce railway officials, directors and chairmen to realize the value of scientific data, and a scientific education in railway traffic problems have been in a large measure frustrated by the unscientific training and active hostility of persons to whom they wished to bring advantage.

Men in the service who saw the defects of rule-of-thumb methods in an age of science were cold-shouldered and even threatened with dismissal if they ventured to give expression to their views. Lecturers at the classes for railway officials were forbidden to refer to the scientific data by means of which alone railway officials could be trained in the science of railway transportation, while well-known railway experts who were honest and bold enough to indicate where things were wrong, and how they might be righted were treated with scant courtesy. And now the chairman of a great company, who has himself supported the old haphazard, happy-go-lucky methods, not only tells the world that the officers of British railways are practically useless, but hands over one of the prizes of the railway profession to a man who has been trained upon lines which the well-informed have for many years desired to introduce into Great Britain.

A lack of harmony and authority among the various departments, and a consequent lack of cohesion in action cannot do other than bar the way to progress. To this end a master mind is needed capable of grasping the entire questions at issue and bringing order out of chaos and directing the forces to the best end. Such a mind must be trained in a new school and capable of molding out of such materials that are at hand, a vitalizing and new force that shall at once reflect the will of the guiding intellect to higher and better results.

It must be admitted, however, that in point of safety the supremacy of the British railways must be conceded. This is not, however, a question proving superior management but is a simple reflex of different conditions. A small, compact country with every mile of its railways fenced and guarded almost precludes the possibility of the large casualty list that marks the statistics of American railroads, but now that the minds of the American railway officials are directed towards this sad phase of railway traffic the results are already seen, and the future is full of promise.

Learning to Be a Locomotive Engineer.

The increasing complication of railway mechanical appliances that the master mechanic of a railway is nowadays expected to exert intelligent control over, calls for the employment of men with first-class mechanical training, so that the chances for a man who begins work as a firemen reaching the position of master mechanic are becoming small. The position of road foreman of engines is directly in line for the intelligent fireman, and he may work up to be a railway president as Mr. Daniel Willard has done, but much self-denial and close attention to duties are necessary in working up to high positions.

The following notes of advice to firemen are still seasonable, although they were written years ago by a man who had just been promoted to the right hand side. In the course of a few years he became train master, then superintendent, and he is now a general superintendent on one of our most important lines.

Our friend wrote: "The attention of firemen is directed to a few facts intended for their benefit and in aiding them to secure promotion in case they deserve it. Nearly all engineers have an appreciation of a clean engine, for it is the machine with which they earn their living. The locomotive cab is the office of the engineer, who pulls the train from city to city and from ocean to ocean. The cab and exterior parts of an engine are to the engineer the same as the office of a master mechanic. We, as employees of a railroad company, very well know that all offices must be kept clean and tidy during business hours, and everything appropriately arranged in the office before the officials resume their duties for the day. So it should be in the cab of a locomotive, especially those used for pulling passenger trains. When an engine is coupled to a passenger train, it should present a clean and tidy appearance, for it is a part of the company's equipment for which they have paid a large sum of money.

"The master mechanic intends, when an engine leaves the yard, that it is clean and merits the admiration of passengers and other beholders. The exterior of the engine depends for appearance upon the interest which the fireman takes in his occupation. The fireman is a locomotive engineer's helper and in fact an apprentice to the trade of locomotive engine running, for it is supposed that he accepted the position of fireman as the means for preparing himself to running

and managing an engine. His duties are numerous, but if he takes proper interest, the work will be found pleasant after a little experience, especially if they are undertaken in the proper spirit. The time to learn the business of locomotive engineering is when the candidate is performing the duties of locomotive fireman."

Artificial Lighting.

We understand that the committee of the Master Mechanics' Association appointed to report on minimum requirements of headlights, of which Mr. D. F. Crawford, of the Pennsylvania Lines, is chairman, has prepared what is likely to prove one of the most valuable and voluminous reports ever presented to an annual convention. The designing of lenses for ordinary train lamps and for station signal lamps has received extended attention from scientific experts, but the locomotive headlight has "growed," like Topsey, without much scientific control. The headlight grew by degrees from a mere indication lamp to a great beacon expected to illuminate the track, to show up any obstruction and to act as an important promoter of safety. This was the American idea, which was not shared by railway people of other countries, who believed that the proper function of a locomotive headlight was to indicate to people at stations and other parts of the right of way that a train was approaching. As there has been some conflict of opinion concerning the real value of headlights, it is hoped that the coming committee's report will throw needed light upon the subject.

The entire subject of artificial lighting is interesting, and an exhaustive history of the development of artificial lighting would make interesting reading. The tremendously brilliant illuminations of streets and buildings in such cities as New York and Chicago would give an ordinary beholder the idea that such brilliancy could have been secured only by long centuries of developing labor, but that would not be correct, for people that have not reached the Scriptural age of three score and ten years have witnessed the introduction of all illuminating improvements from the whale oil crusie to the electric arc light.

The sun and sunlight make ideal illuminants, but their light is not always in evidence, so it is difficult to conceive a time when artificial light was not required. The earliest means of artificial lighting was the torch, not the oil and cotton wick apparatus of railroad service, but a pine stick smeared with rosin. The next advance was to what was known as the link, which was a rope instead of the pine stick, the improvement being the lengthened time of use. The link held sway for many centuries, and link-boys lighted the way for fashionable people up to the time that Murdock's gas was introduced for street lighting. It would be an easy advance from a torch to a crude candle, as the first candles were merely lumps of fat with a hole cut in for the wick. The candle was no doubt the immediate successor of the torch, and it held sway from remote times, although oil lamps have been found in the ruins of Pompeii. It seems that very little progress was made in developing lamps, for those used in Italy before the beginning of our era were practically the same as those used in Scotland when Queen Victoria ascended the British throne.

The nomenclature of the Greeks and Romans concerning artificial lighting was very confusing, for candle and candlestick were used in the same sense as lamp. An incident is mentioned in Apullius' Metam, where an alarm arose in a Roman household, and the people rushed together with taedis, lucernis, sebaceis and cereis, which means with torches of pine, lamps, tallow candles and wax tapers. At Herculaneum a chandlers apparatus was found in working order; and in the British Museum there is a fragment of a huge candle found in Vasion, Asia Minor, supposed to have been made in the first century.

Modern men and women came to admire the kerosene, and found it an immense improvement over the odorous whale oil crusie; but give us the incandescent electric light.

Misplaced Skill.

The men who manage eastern railroad shops could often learn useful lessons by watching how work is done in similar shops in the West. Mechanics do not relish the idea of looking westward for instruction, but it might often be done with profit. The ornate elaborations of outside finish that were so common on motive power a few years ago, are almost extinct, but there is still to be found in some quarters a tendency to put work where it is entirely wasted. Western mechanics were the first to realize that a job was well enough done for all practical purposes without being finely finished.

Another thing that has stopped unnecessary labor has been watching the manner in which mechanics in other lines of work, outside of railroad shops, perform their operations. The ordinary machinist, when he speaks of a first-class workman, means a man who is fine, close and accurate, such as a mechanic capable of doing first-class work in a tool room and equal to finishing properly the most difficult jobs required to be done. Such a man is to be envied, but other men who never succeed in turning out finely finished work may be as good and useful mechanics as the other, or even more so.

There are just as good men working on rough, portable engines as can be found in tool shops. They are skillful men, but put them into shops turning out closely finished work and they are gone. Fact is they should not try the fine finish. In the same way the tool maker would not be worth his salt on portable engines. He may be hard at work all the time and accomplish nothing. Some people think that work cannot be too well done, which is nonsense. There is more machine work done too well than too bad. Bad work is simply labor misplaced. A skilled workman is one understanding the tricks and art of his trade. Knowledge in his case is frequently of greater value than manipulative skill. If he has the judgment and common sense which tells how and where to apply his skill, he is a good and valuable workman. If he does not know where to apply his skill, he cannot be depended upon to do his best without constant supervision, and his services are not first-class.

Effect of Wetting the Coal.

In talking with a very intelligent engineer on various methods of getting the best work out of a locomotive, he put the question, "Is it better to fire with dry coal or with the coal wet? Some men say," he continued, "that the wetter the coal, the hotter the fire it will make, and they refer to the example of the blacksmith who from time immemorial has been in the habit of wetting his coal to help in getting an intense heat. This is done, everybody admits, and it would not be done if the blacksmith did not find that the practice helped him. It looks, however, as if the firebox of a locomotive acted differently from a blacksmith's forge, and I scarcely think that the cases are exactly the same. I know when there is much snow mixed with the coal that it is hard making an engine steam, and snow ought to intensify the heat if water does so. It is common sense to think that water dampens and cools a fire, and I take no stock in wet coal acting the opposite way when thrown into a firebox, the blacksmith practices notwithstanding.

Decidedly our friend was right. Strange as it may appear, there is a widespread but erroneous impression that wetting the coal fed to a locomotive firebox intensifies the heat of the fire. This, no doubt, arises from the practice of the blacksmith alluded to, but the blacksmith wets his coal to form an outside shell which keeps the heat concentrated about the forging, not that he imagines that wet coal will create more heat than dry coal. When wet coal is thrown into a furnace, a portion of the heat already generated is wasted evaporating the water before the coal can begin to perform its functions of fuel. Every pound of water thrown into the firebox with the coal has

to be evaporated, just the same as the water employed in steam making, and coal has to be wasted in doing the operation. Evaporating water in a fire-box has some disadvantages peculiar to itself, and the practice would be less common if those who encourage it fully realized the great waste of heat that results. Wetting the coal to some extent is necessary to keep the men in the cab from getting blinded with dust, and it sometimes gives sufficient adhesion to stack coal to keep the finer particles from going direct from the scoop into the flues. But to suppose that any increase of heat could result from coal being saturated with water is the mistake of silly ignorance.

Exhaust Pipes, Nozzles, and Steam Passages.

The exhaust pipes, nozzles and steam passages of a locomotive engine perform very important functions besides that of passing the steam from the cylinders to the atmosphere; but unfortunately the engineering world has not given this part of the engine the attention it deserves. Next to the invention of the multi-tubular boiler, the intense draft induced by passing the exhaust steam through the smokestack proved of the greatest service in making the locomotive a successful producer of motive power. The tubular boiler and the steam blast, provided for extraordinarily rapid generation of steam with the small boiler, that it was practicable to carry on a movable machine, and they are two of the essential elements of even a moderate speed locomotive. When the improvement of passing the exhaust steam through the chimney was first discovered the engineers of the time supposed it mattered little how the exhaust pipes were designed or located so long as the steam was passed in with sufficient velocity to cause a rapid flow of the gases of combustion though the flue tubes.

They soon discovered, however, that when the boiler was deficient in steam-making capacity, compared with the demands of the cylinders, that the generating power could be stimulated by restricting the exhaust opening. This quickly became a popular mode of increasing the steam-making capacity of boilers, and the injudicious use of this means has led to enormous waste of fuel. Generations of men in charge of motive power have found closing the nozzles a convenient and easy means of stimulating steam-making, and it has been constantly resorted to when those anxious to obtain a greater supply of steam ought to have been searching for means of imparting to the water inside the boiler more of the heat coming from the fuel burned, instead of increasing the means of burning more fuel. Until very lately in this country inordinate consumption of coal, in proportion to the work done, put very little restraint upon the bad proportions of draft appliances. The first check met with by those who favored the use of small nozzles was in the dangerous throwing of sparks carried through the flues by the suction of the sharp exhaust; the second check to the restricted escape of steam from the cylinders was loss of power caused by excessive back pressure in the cylinders.

A careful study of the development of the American locomotive appears to show that the able mechanical engineers who who have brought the engine to its present high standing have been singularly apathetic about improving the draft appliances. Many of the men who have been leaders in carrying out improvements on other parts of the engine were well versed on the laws relating to induced currents, and they must have been aware of the influence that the form of an exhaust pipe has on the height of a vacuum created, yet they were contented to press the steam from the cylinders of locomotives through the worst forms of openings and passages. No end of ingenious labor has been devoted to preventing the sparks from escaping through the smoke stack that a viciously sharp blast has drawn through the flues; double nozzles were introduced to prevent ruinous back pressure in the cylinders, which would have resulted from both cylinders exhausting through one small nozzle; but no labor to speak of has been expended on trying to improve the design of the parts that tended to cause so much fire throwing and loss of power from piston resistance. Although the effect of small changes on the exhaust pipes and nozzles of locomotives has always been apparent enough to excite attention, and although the influence of these parts has always been highly conspicuous on the economical operation of the engine, they have been strangely neglected considering their obvious importance.

Among the numerous subjects to be reported upon at the next Master Mechanics' Convention, "Exhaust Pipes, Nozzles and Steam Passages" does not appear. We suggest that the subject be taken up in the near future, although we think it would be a good subject for consideration by the Traveling Engineers' Association.

The Alaskan Railroad.

We wonder if the determination of the United States Government to construct a railway in Alaska is not the entering wedge through which politicians will strive to put all our railways into government ownership. The case of Alaska needing help in the building of railways is exceptional, for the people of that territory are not able to do the work themselves, and government help is the only way to have the necessary enterprises carried out.

The work of building the Alaskan Railroad will be of an extensive character, for a bill has been passed by Congress authorizing the expenditure of $35,000,000. The railroad building and operating will give employment to a small army of railway employes who ought to be drawn from the idle railway men in the United States. People wishing to secure jobs on this railway should apply to Secretary Lane, Washington, D. C.

Tree Planting.

There was for several decades a fashion of tree planting manifested among railway companies, but the fashion seems to have died out. A wise saying tells us that "he who plants a tree does a good deed even though no member of his family may ever live to enjoy its shade." The increasing variety of steel products makes some people believe that timber is growing of less importance to railways, but that is a mistake. Steel, to be sure, is rapidly monopolizing the car building industry, but no metallic form has proved itself to be a satisfactory track tie. We cannot help thinking that the ever growing demand for track ties will keep straining the timber supply available in the American continent and that under its stress the necessity for more tree planting will be recognized.

Too Strong.

When any part of a car or locomotive keeps breaking, the obvious remedy is to make it stronger, but in some cases this cure may be carried too far. At a recent meeting of railroad men we were discussing this subject, and a well known master mechanic remarked: "One time years ago I was much annoyed by crank pins breaking, so I determined to make them so big that they could not break. I increased the hub to 5½ inches and the diameter of the pin to 4½ inches. I felt there would be no more breakage of crank pins, but a worse thing happened. I got a succession of broken driving wheels and I shall lose no time in getting back to the 4-inch crank pin."

Reciprocity.

You cannot get good service from a railroad without compensation. Experience has proved that the more prosperous the railroad company the better their roadbed, their trains and their service. In other words, you get what you pay for. Starvation rates mean poor roadbed, poor equipmeint and poor service. Not only so, but when the railroads are prosperous they naturally find new fields for expansion, with the result that the development of the country is in a large measure coincident with the development of the railroads. A period of business depression on railroads is a halt in national progress.

Elements of Physical Science

By JAMES KENNEDY

VI. LAWS OF MOTION.

The generic principles in the laws of motion are two important factors, one being that a body at rest remains at rest, and the other that a body in motion moves in a straight line with uniform velocity, unless acted upon by some external force. No body has power of itself to move or cease moving, if in motion, or to change its direction or velocity.

It will be observed that with the exception of falling bodies, all other bodies in motion move in curves. This is in consequence of their being acted on by other forces besides those that set them in motion. The tendency of all moving bodies, however, is always to continue in a straight line, even when from overruling causes it moves in a circle. Throwing a stone from a sling is a good illustration of this law. The force which tends to make a body fly from the center around which it revolves is called the centrifugal force. The opposite force, which draws a body towards the center around which it revolves is called the centripetal force.

The most stupendous examples of these two forces are exhibited by the planets revolving around the sun. In obedience to centrifugal force, they tend to fly off into space in a straight line. This tendency is checked or balanced by a centripetal force equally powerful. The attraction of the sun is such that the planets are restrained in their force, with the result that they revolve in curves which keep them moving in a perpetual circle.

To counteract the effect of the centrifugal force in curves on railroads, the outer rail is laid higher than the inner rail. Were it not for this precaution, trains moving swiftly around a curve would be thrown from the track. It may be stated in this connection that a certain amount of elevation of the outer rail is adapted to a certain amount of velocity, and it is of importance that trains moving on curves should do so at the velocity for which the elevation of the outer rail is adapted. Several terrible disasters both in America and Europe have occurred in recent years by disregarding this necessary precaution. It may also be added that in the case of what are known as cross-overs where it is not yet possible to elevate the outer rail, the speed should be comparatively slow as the impact of the wheels of a heavy locomotive running at a high speed induces a tendency to jump or climb the rails. The higher the rate of velocity of a moving train, the higher should be the outer rail. The running of a horse around a circle is an illustration of how instinct teaches the lower animals the necessity of leaning to the inner side in running in a curved line. The circus-rider will also be observed to lean farther inward as the speed increases.

VII. LAW OF CENTRIFUGAL FORCE.

The centrifugal force of a revolving body increases in a ratio of the square of the velocity. If one body moves twice as fast as another, its centrifugal force would be four times as great; if three times as fast—nine times as great; if four times as fast—sixteen times as great, and so on. It will be readily observed that in the act of whirling a stone around in a sling, the tendency to break the cord is greater under a rapid motion than a slow one.

It will also be noted that centrifugal force acts not only on bodies moving in curves, but also on fixed bodies moving on their own axes. In the case of large wheels being turned rapidly, the centrifugal force at the circumference becomes an agent of great power. If such wheels are not made of strong materials, their cohesive force will be overcome by the centrifugal force, and they will break into pieces. Breakages of this kind frequently occurred to emery wheels, but this has fortunately been largely overcome by recent improvements in their construction.

In the case of bodies revolving on their own axes, all parts having to complete their revolution in the same time, and as we have seen that the centrifugal force increases with the square of the velocity, and it being necessary that the farther from the axis the parts are, such parts have a greater distance to go, and must necessarily move faster, therefore the centrifugal force is stronger at the outer edge than at any other part of the revolving body. In revolving spheres, the centrifugal force is greatest at the equator, and diminishes from that point till at the poles it disappears. This force affects the form of the earth, and more especially some of the planets that are still in a plastic state, the flattening at the poles being particularly marked in the planet Jupiter.

VIII. ACTION AND REACTION.

Action is the force which one body exerts on another subjected to its operation. Reaction is the counter-force which the body acted upon exerts on the body acting. Reaction is always equal to action, and opposite to it in direction. In the discharging of a gun, the exploding power carries forward the ball, but the blow struck on the shoulder of the person firing the gun is the exact equivalent of the force that carries the ball.

Action is often nullified by reaction. A man rigged a bellows in the stern of a sailboat in order to raise wind. The reaction on the bellows by the air was such that the boat would not move. A similar case was that of the man who tried to raise himself over a fence by pulling at the straps of his boots. The upward impulse was exactly counterbalanced by the downward impulse.

As we have stated, action and reaction are equal, but are exhibited differently in elastic and non-elastic bodies. This is shown in the case of a non-elastic ball striking a ball of a similar structure. Both bodies will move in the direction struck half the distance that the striking ball would have moved if unimpeded. If the two balls are of ivory, or other highly elastic substances, the striking ball will impart its motion to the one at rest and remain stationary after striking, while the ball struck will move the same distance as the striking ball would have reached if unresisted, that is, if there is no serious amount of frictional resistance.

Reflected motion is the motion of a body turned from its course by the reaction of another body against which it strikes. The angle made by the body in its forward course with the perpendicular at the point of contact is called the angle of incidence. The angle made by the body in its backward course is called the angle of reflection. The angle of reflection is always equal to the angle of incidence. A ball may be thrown to the ground at various angles. The lines of recoil always form the same angles as those formed by the lines of projection.

Smarter Than He Looked.

There was a professor of mathematics once in Virginia, near the home of George Washington, who had a class for the teaching of surveying, and was something of a martinet in his method of teaching. Having a dull boy under examination in a class of surveying, the boy not being able to understand even the simplest explanation aroused the wrath of the teacher who exclaimed: "You ought to be ashamed of yourself. When George Washington was your age he surveyed my county and had not even an instructor."

The boy began to laugh and seemed so much amused that the professor demanded to know the cause of the boy's merriment. The reply was, "When George Washington was your age he was President of the United States."

Air Brake Department

Air Brake Convention.

As previously stated in these columns, the twenty-first annual convention of the Air Brake Association will be called to order in the convention hall of the Hotel Pontchartrain, Detroit, Mich., at 9:30 A. M., Tuesday, May 5, 1914.

Previous to the 1913 convention Mr. H. A. Wahlert, president-elect of the Air Brake Association, retired from railroad service to accept a position with the Westinghouse Air Brake Company, and Mr. W. J. Hatch became the presiding officer at the St. Louis convention. About the same time Mr. J. T. Slattery was appointed division superintendent of the D. & R. G. R. R., and wished to sever his official connection with the association. During the St. Louis convention, the writer was under the impression that Mr. Hatch had, through the retirement, been advanced to the presidency; however, at this meeting Mr. W. J. Hatch was duly elected to the presidency, Mr. L. H. Albers as first vice-president and Mr. J. T. Slattery as second vice-president. Consequently Mr. Hatch will be the chairman at the Detroit meeting.

The papers and subjects to be presented for discussion and the authors are as follows:

1. Electro-pneumatic signal system for passenger trains, by L. N. Armstrong.
2. Air hose, by T. W. Dow.
3. Clasp type of foundation brake gear for heavy passenger cars, by T. L. Burton.
4. Air gage and conductor's valve in caboose cars, by Mark Purcell.
5. The analysis of the factors involved in controlling and stopping passenger trains, by Walter V. Turner.
6. One hundred per cent. efficiency of freight train brakes, by Fred Von Bergen.
7. Recommended practice, S. G. Down, G. R. Parker, H. A. Wahlert, J. R. Alexander and N. A. Campbell.
8. Topical subject — Mountain grade work, by H. H. Forney.
9. Topical subject—Modern train building, by G. W. Nolan.

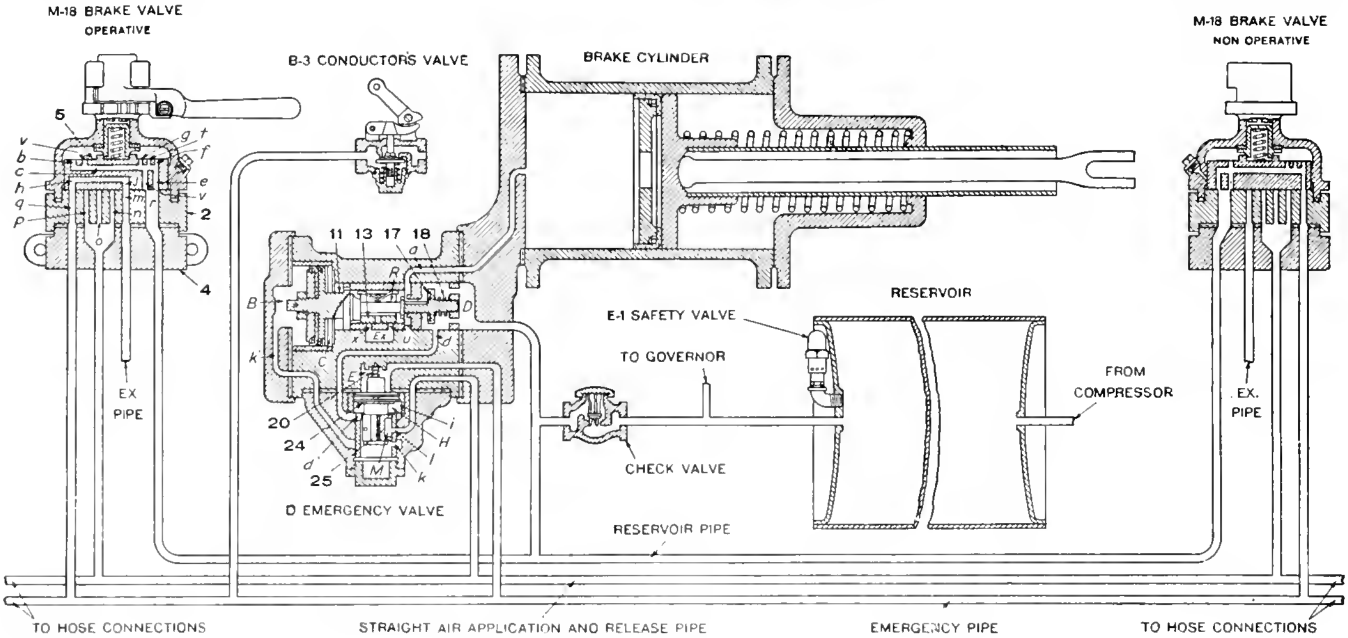
Equipment S. M. E.

In air brake practice, electric transmission of the operator's intent cannot become a necessity until the pneumatic features of the brake are developed to the highest possible state of efficiency, and before the advantages of electric operation can be thoroughly understood the features of the pneumatic portion must first receive attention. It is first necessary to recognize the improvements in pneumatic or compressed air brakes, and for the purpose of illustrating that which has been made for electric service it is desired to begin with the equipment S. M. E.

The illustrations show the M 18 brake valve, the type D emergency valve, which is the operating valve, and a diagrammatic view of the general arrangement. This is a combined automatic and straight air equipment in which service and emergency features are entirely separated, hence the possibility of undesired quick-action is absolutely eliminated, while the quick-action or emergency application can be obtained at any time regardless as to previous reductions. The quick-action is obtained upon the movement of the brake valve, opening of the conductor's valve or a rupture of the emergency pipe or hose connections.

A graduated release and the usual graduated application makes possible the instant increase or decrease in brake cylinder pressure, and gives the maximum flexibility in operation.

The type D emergency valve controls the admission and exhaust of brake cylinder pressure, and it is really a modified form of the distributing valve for steam locomotives. On motor cars the brake



S. M. E. EQUIPMENT IN EMERGENCY.

cylinders receive compressed air from the main reservoir, while on trailer cars an auxiliary reservoir may be attached at the reservoir connection of the emergency valve. In charging the equipment, main reservoir pressure flows through the reservoir pipe to the brake valve, governor, gage and emergency valve direct. The emergency pipe is charged through a feed groove past the emergency piston, and this is augmented by a small port through the brake valve rotary and is open in all positions of the brake valve except in emergency. There are two portions of the emergency valve, one called the equalizing portion, the other the emergency.

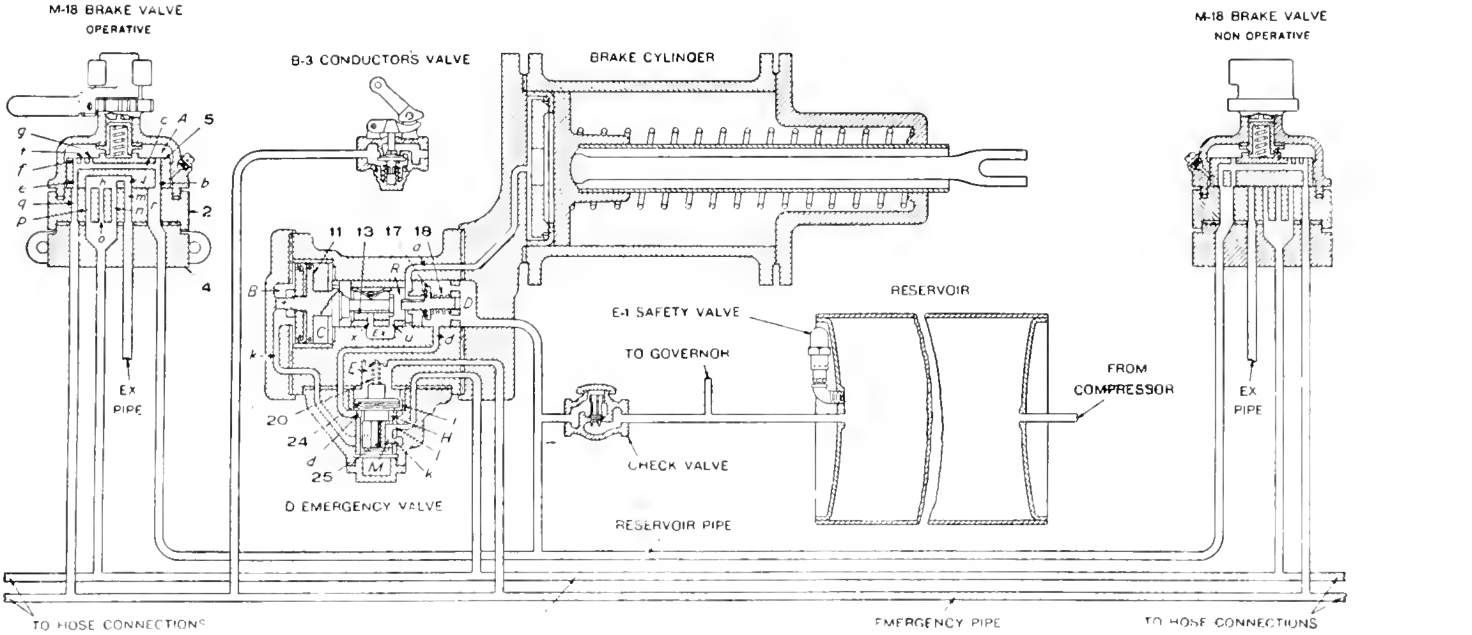
The brake valve and emergency valve are connected by the emergency pipe and a straight air application and release pipe, both pipes having hose connections at their ends whereby they can be connected

with other motor or trailer cars for brake operation. As is the usual custom in electric service, there is a brake valve at either end of the car, one being in lap position with its handle removed while the other is in operation.

By comparing the sectional view of the emergency valve with the diagram of the equipment in release position, it will be observed that main reservoir pressure flows to check valve 17, thence to the chamber in which the emergency slide valve operates. The emergency pipe is connected with the opposite side of the emergency piston and the pressures on each side are in communication through the feed groove in the piston bushing. The application and release pipe contains atmospheric pressure, while main reservoir pressure surrounds the brake valve rotary.

When a service application is desired, the brake valve is placed in the proper notch, for one-car or two-car service, and and maintained regardless as to piston travel or leakage. When a release is desired, the brake valve in use is placed in release position and the rotary valve and seat form an opening from the application and release pipe to the atmosphere which permits brake cylinder pressure to force the equalizing piston to release position and move the exhaust valve to uncover the exhaust port from the brake cylinder to the atmosphere. The graduated release is thus obtained by alternating the brake valve between lap and release positions.

In the event of a sudden opening in the emergency pipe, which would be caused by rupture, opening the conductor's valve or moving the brake valve to emergency position, the pressure in the emergency pipe will escape at a faster rate than the pressure in chamber M can feed back into the emergency pipe; consequently the emergency piston will move the slide valve to emergency position in which this slide valve instantly admits



S. M. E. EQUIPMENT IN RELEASE.

pressure from the main reservoir flows through suitable ports in the brake valve to the straight air application and release pipe, then through a cavity in the emergency slide valve to the chamber B in the equalizing portion of the emergency valve. This moves the equalizing piston to the right, the exhaust valve closing the brake cylinder exhaust port and the equalizing piston unseats the check valve 17, admitting main reservoir pressure to the brake cylinder to a pressure equal to that admitted to the chamber B.

Pressure in the application and release pipe remaining constant, it follows that, as with the locomotive distributing valve, any loss in brake cylinder pressure would permit the equalizing valve to open the check valve and supply the brake cylinder leak. Thus by admitting compressed air to the straight air application and release pipe, brake cylinder pressure is obtained main reservoir pressure to back of the equalizing piston, applying the brake in full in the shortest possible space of time. When the emergency pipe is again closed and the brake valve placed in release position, its pressure will be restored and pressures on the emergency piston become equal, permitting a spring to return the emergency parts to their normal position, exhausting application and release pipe pressure and brake cylinder pressure to the atmosphere, as previously explained.

Defects of Universal Valve.

In the preparation of any information relative to the disorders liable to develop in any part of an air brake apparatus, it is well to deal first with the duties of the various portions comprising the valve in question and supply some general information that it is necessary to know before the correct operation of the valve is understood, or rather, after the operation is thoroughly understood, the defects the valve is liable to develop are very readily traced.

Past issues contain a very complete description of the universal valve for steam road service, and we wish to first explain the duties of the various portions of the U. E. No. 12 valve, then add a list of the principal disorders that are liable to develop from wear or neglect of the parts.

In the first place there is but one size of universal valve for any size of cylinder or weight of car, hence the rate of increase in brake cylinder pressure during an application of the brake or the time of exhaust of the cylinder pressure during a release of the brake is governed by choked passages in the pipe bracket which is a fixture on the car, and the sizes of the openings correspond to the size of brake cylinder that is employed.

The auxiliary reservoir for all equipments is 10 x 33; the size of the service reservoir varies with the size of the brake cylinder and is so proportioned that the combined volumes of the auxiliary and service reservoir equal the volume of the proper sized auxiliary as standard in the P. M. brake equipment; that is, for a 16-in. cylinder the 10 x 33 and a 14 x 33 would equal the volume of a 16 x 33, the proper sized reservoir for the 16-in. brake cylinder.

The emergency reservoir for the 16-in. cylinder is a 20½ x 48, used to provide high pressure emergency, graduated release and recharge of auxiliary and service reservoirs.

The volume or capacity of the quick action chamber and quick action closing chambers is 150 cu. ins. each. The rate of reduction necessary to reduce quick action is 20 lbs. in 2½ seconds and is in no wise influenced by the equalizing portion, as service and emergency operations

are entirely separated. This corresponds with the rate of reduction necessary to move triple valves to quick action which is generally understood to be at the rate of from 6 to 8 lbs. per second.

In emergency applications the time of exhaust of pressure from above the quick action piston is about 10 seconds; this length of time is intended to make a stop necessary after an emergency application whether a stop is desired or not; it is not intended to encourage the promiscuous use of emergency position of the brake valve.

The charging time of reservoirs in service or with brake pipe pressure maintained is: auxiliary reservoir, from 0 to 105 lbs., in 40 seconds; service reservoir, from 0 to 105 lbs., in 45 seconds; emergency reservoir, from 0 to 105 lbs., in 84 seconds.

After a 25 lb. reduction the auxiliary reservoir should recharge to 110 lbs., in from 8 to 12 seconds.

In graduated release position, the auxiliary reservoir is recharged from the emergency reservoir at the same rate that brake pipe pressure is restored, and as the emergency reservoir is seven times the size of the auxiliary, a very finely graduated release is possible; in fact, more graduations can be made than ever will be necessary.

The present No. 12 valve differs slightly from the one originally shown in these columns in the emergency portion in that a graduating valve has been added to the emergency slide valve; otherwise any previous references to the universal valve are applicable to the present one.

The duties of the equalizing piston are to close and open the auxiliary and emergency reservoir charging ports, actuate the equalizing slide and graduating valves, and to limit the brake pipe reduction in electric service application.

In passing, it might be repeated that the equalizing portion controls the application and release of the brake and the charging of the reservoirs, while the emergency portion controls the quick action and high pressure functions.

The duty of the equalizing slide valve in release position is to separate the service and auxiliary reservoir, to connect the release end of the release piston to the atmosphere, to blank the port leading to the application end and close the service port.

In application position, it connects the service and auxiliary reservoir, blanks the port leading to the release and of the release piston, opens the port leading to the application end to the atmosphere, and opens the service port to the brake cylinder.

The duty of the graduating valve in release position is to close the service port in the slide valve, connect the release end of the release piston through the slide valve to the atmosphere, and connect the resistance increasing cavities in the slide valve to the auxiliary reservoir. In application position, it opens the service port in the equalizing slide valve, connects the application end of the release piston to the atmosphere, laps the port leading to the release end of the release piston, and connects the resistance increasing cavities to the atmosphere.

The release piston and slide valve in release position opens the service reservoir charging port, the emergency reservoir charging port, the high pressure valve port, the graduated release port and the brake cylinder exhaust port. In application position, it closes these ports and connects the high pressure valve port to the seat of the emergency slide valve and connects a bleed port from the equalizing slide valve to the atmosphere.

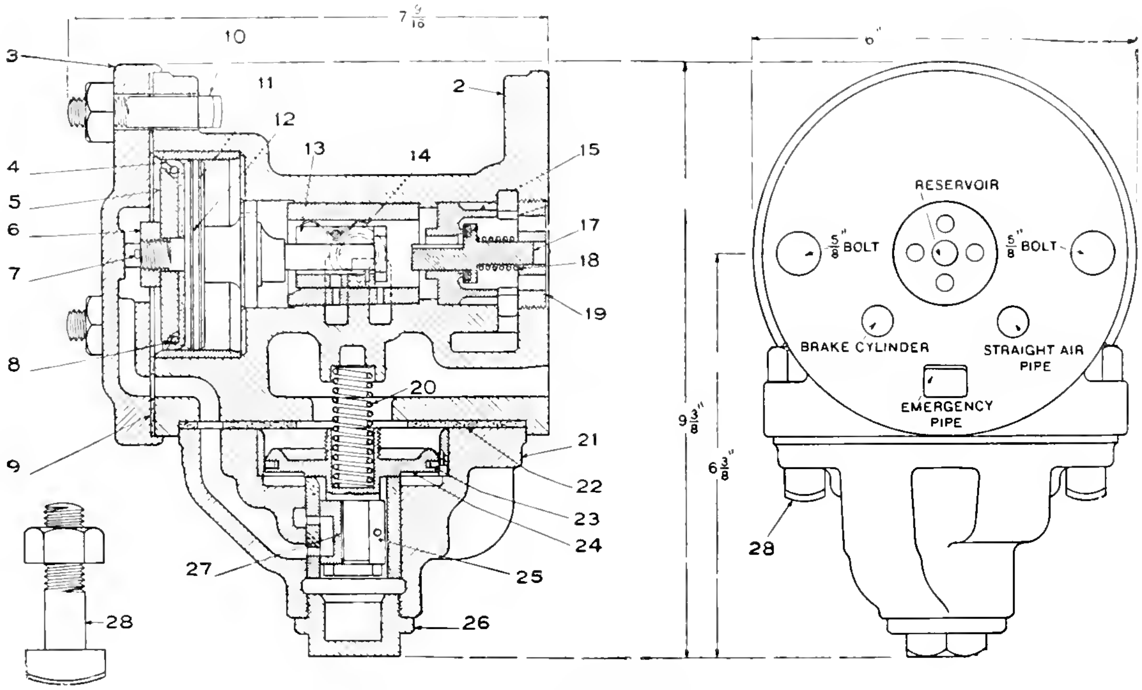
It has been stated that one of the duties of the equalizing piston is to limit the amount of brake pipe reduction in electric service application; this may be said to be the duty of the reduction limiting valve which is located in the equalizing piston and moved by it.

The object of the service reservoir charging valve is to prevent the charging of the service reservoir until such time as the auxiliary reservoir pressure is within 5 lbs. of the emergency reservoir pressure.

The object of the service port check valve is to prevent a back flow of air from the brake cylinder into the service and auxiliary reservoirs. The idea is to first equalize auxiliary, service reservoir and brake cylinder in an emergency application, then cut off these reservoirs and permit the emergency reservoir to equalize with the pressure already obtained in the cylinder. Then when a release is desired, only the auxiliary and service pressure need be exceeded; this service port check valve at such times prevents the higher brake cylinder pressure from flowing back into the service and auxiliary reservoir.

The emergency charging port check valve prevents emergency reservoir pressure from passing back to the equalizing piston chamber and the brake pipe when a service reduction is attempted; however, when the release piston is moved to application position, the slide valve also closes the emergency reservoir charging port.

The graduated release piston is used to hold the equalizing piston and slide valve



TYPE D EMERGENCY VALVE.

in graduated release position when the graduated release is cut in; this is accomplished by turning the graduated release cap (release piston cylinder cover) in the proper position.

The duty of the protection valve is to cause an emergency application of the brakes when from any cause whatever the brake pipe pressure is reduced to 35 lbs. The high pressure valve acts as a pilot valve for the intercepting valve and opens and closes a large port leading to the brake cylinder during an emergency application.

The intercepting valve controls the admission of compressed air to the brake cylinder during emergency applications; it first permits of the service equalization, then cuts off service and auxiliary reservoirs and equalizes the emergency reservoir pressure and the brake cylinder.

The duty of the safety valve is to limit the brake cylinder pressure to 60 lbs., for service operation, and the cut off valve permits this brake cylinder pressure to pass to the safety valve in service, but in emergency operation it cuts out and unseats the safety valve and permits of a passage of air from all three reservoirs to the brake cylinders in their proper order; thus the maximum brake cylinder pressure obtained is held to the stop.

The duty of the emergency piston and its slide valve is to open and close the quick action chamber feed groove, which is done by the piston, and the slide valve in release position opens the quick action closing chamber port and connects the face of the high pressure and cut off valve to the atmosphere.

In application position the slide valve first connects the quick action chamber to the quick action piston and emergency switch piston, then closes these ports, then opens a connection from the quick action closing chamber to the quick action and emergency switch pistons, closes the quick action closing chamber port, then connects the back of the high pressure valve to the atmosphere through a cavity in the release slide valve and connects the quick action chamber to the brake cylinder.

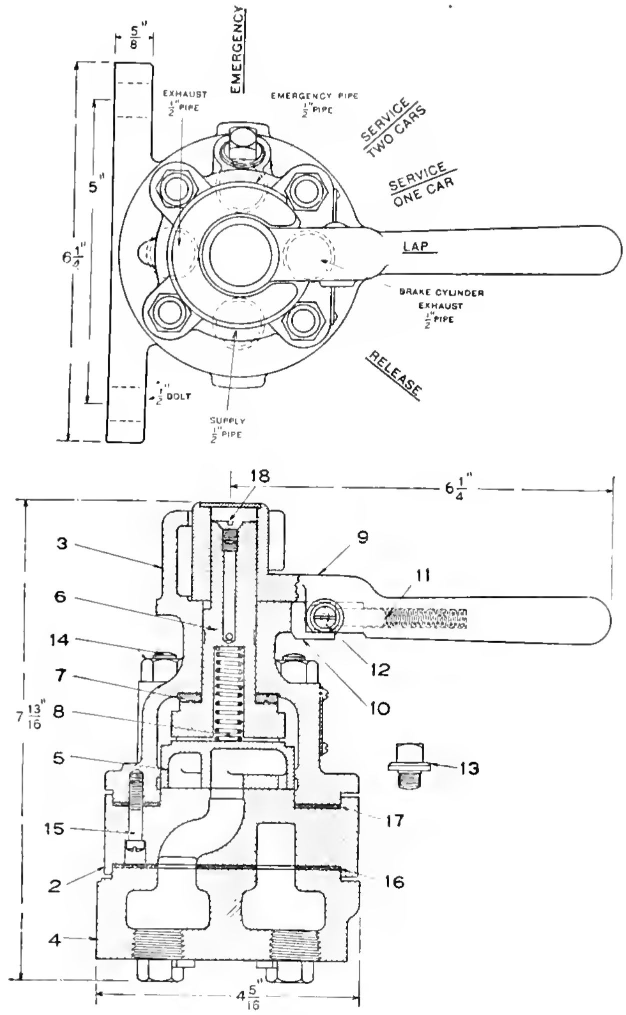
The emergency graduating valve is used to open and close communication between the quick action chamber and the quick action piston and emergency switch piston.

A special stop cock is located in the brake cylinder pipe whereby the brake cylinder can be cut out and the pressure retained in the reservoirs. The movement of turning this cock cuts off pressure from the cylinder and at the same time opens it to the atmosphere. There is also a threaded opening in the side of the cock where a gauge can be attached to test the brake cylinder for leakage. By the use of this cock a brake shoe can be applied without the necessity of cutting out and bleeding the large volumes from the reservoirs, and in the event of broken brake rigging the cylinder can be cut out without destroying the water raising system.

The object of dividing the service volumes for the brake cylinder is to prevent a drain on the brake pipe when releasing brakes; in this arrangement only the small auxiliary reservoir draws air from the brake pipe when the valve is in direct release position, and when in graduated release both reservoirs are charged from the emergency reservoir, and there is no opportunity for any part of the equipment to absorb brake pipe pressure during a release of brakes; that is, all brakes will have had ample opportunity to release before the recharge from the brake pipe can take place.

We have called attention to the use of two emergency reservoirs or rather a divided emergency reservoir volume during the transition period. With this arrangement a small 10 x 33 emergency reservoir is added, and a cut out or limiting valve is placed in the pipe leading to the large emergency reservoir; thus in emergency applications the large volume is cut off from the brake cylinder until such time as all cars are equipped with universal valves. Without the limiting valve about 150 per cent. braking power is obtained in emergency; incorporating the valve reduces the emergency braking power to about 113 per cent., which more nearly or temporarily conforms to emergency pressure developed by triple valve equipments.

Now, when an attempt is made to locate the source of any disorder of the universal valve, it must be remembered that the equalizing piston is operated by variations in brake pipe and auxiliary reservoir pressure, and that emergency reservoir pressure is always present between the two pistons of the release valve structure, and at the present time all valves are to be operated in direct release position and until such time as a sufficient number of cars are equipped to warrant the use of graduated release.



M-18 BRAKE VALVE.

To cut out the universal valve, close the stop cock in the brake pipe and bleed all reservoirs.

If it is desired to retain emergency reservoir pressure for the water raising system, make an emergency application of the brake, then bleed all reservoirs except the large emergency.

To cut out for a brake cylinder or brake

rigging defect, close the stop cock in the brake cylinder pipe, which will simultaneously bleed the brake cylinder.

To bleed off the brake, open the bleed cock in the auxiliary reservoir and close as the brake starts to release.

Short puffs of air from the exhaust ports are not defects of the valve mechanism; the one that occurs from the equalizing valve exhaust at the start of the application is from the resistance increasing cavities in the equalizing slide valve and from the application end of the release piston.

The short discharges at the start of a release are from the release end of the release piston through the equalizing valve exhaust port and from the auxiliary reservoir through the release valve exhaust port.

Previous issues contain an explanation of the features of positive release, certainty and uniformity of application, and immunity from response to unintentional variations in brake pipe pressure, which are accomplished through the reductions in pressure indicated by these exhausts of air from the equalizing and release valve exhaust ports at the beginning of application and release. If, however, these blows do not cease upon the movements of the valves, they indicate some disorder of the valve mechanism.

A blow at the equalizing slide valve exhaust when the brake is released may be from the equalizing slide valve, graduating valve, or from the seal at the release end of the release piston.

In application position it would be from the same slide valves, or from the seal at the application end of the release piston.

In release position a blow from the release slide valve exhaust would be from a leaky release slide valve; in application position it could be either from the release slide or equalizing slide valve.

A blow from the emergency slide valve exhaust port, when in release position, would be from a leaky emergency slide valve or from the seat of the high pressure valve. In emergency position the blow could be from the emergency slide valve, the release slide valve or the outside seal of the high pressure valve.

The heavy blow from the emergency piston or slide valve exhaust port, when releasing after an emergency application, is an escape of brake cylinder pressure which ceases as soon as the cut off valve is seated. Should the blow continue, it would indicate that the high pressure valve has stuck open.

A blow at the brake cylinder exhaust when the brake is released may be directly from the release slide valve or from the equalizing slide valve through the service port. Either of these slide valves could cause the blow when the brake is applied, but before deciding that either is at fault it must be known that all gaskets are in good condition and that all bolts and nuts are drawn tight. As the brake cylinder port passes through all three portions of the valve, it follows that any gasket, if leaking, could cause this blow at the brake cylinder exhaust.

A blow at the quick action exhaust port would be from a leaky quick action valve, emergency slide or graduating valve.

A blow from the holes in the protection valve cap will indicate a leaky atmospheric seal when the brake is released. If it occurs after an emergency application, it may be from leakage past the emergency piston packing ring in combination with a leaky emergency piston gasket.

A blow at the emergency piston exhaust, only during a service application of the brake, would be from the brake cylinder past the seat of the cut off valve.

A blow from the safety valve exhaust ports, during an emergency application, would be from the seal of the cut off valve instead of from the piston valve of the safety valve, as the safety valve is at this time unseated by the cut off valve.

In the electric or magnet portion, a leaky emergency magnet valve would cause a blow at the emergency magnet exhaust port.

A leaky service magnet valve, if brake pipe pressure is discharged to the atmosphere during the service reduction, would cause a blow at the service magnet exhaust, but if the brake pipe exhaust is into the brake cylinder, the leaky magnet valve would cause a blow at the brake cylinder exhaust port in release position. The brake cylinder exhaust is then past the release magnet valve.

The object of the magnet valve cut out cap is to cut out these magnets or rather to cut the brake pipe pressure away from the magnet valves should they develop a very bad leak or stick open.

A leaky release magnet valve would cause a blow at the brake cylinder exhaust port when holding brakes applied with the universal valve in release position; that is, at a time the release magnet is energized.

As the normal position of the release magnet valve is open, it requires no cut out cap.

From previous descriptions of the electric operation of the universal valve, the functions of the emergency switch and switch piston, the electric service port check valve and the references to blows at the exhaust ports will be understood.

Next month's issue will contain a summing up of the disorders the universal valve is liable to develop from wear and neglect, and some tests to locate the source of the disorders will also be given.

Classification of Wood.

The relative hardness of woods is calculated by the hickory which is the toughest. Estimating hickory at 100, we get for pignut hickory, 86; white oak, 84; white ash, 77; dogwood, 74; scrub oak, 73; white hazel, 72; apple tree, 70; red oak, 69; white beach, 65; black walnut, 65; black birch, 62; yellow and black oak, 60; hard maple, 56; white elm, 58; red cedar, 56; cherry, 55; yellow pine, 53; chestnut, 52; yellow poplar, 51; butternut and white birch, 43, and white pine, 35.

According to this classification, woods possessing a degree of hardness equal to only about 40 per cent., or less than that of hickory, should not be classed as hard woods. Such woods are, however, limited in quantity and are not of sufficient importance to justify a classification and the practice is to construe hard wood to mean everything except white pine.

A Lucky Traveler.

One of our most observant travelers is Fra Elbertus, who knows whereof he speaks when he says: "Railroad men stand for industry and economy; they are filled with an eternal discontent. They want things better. They are men with the builder's itch."

In another place he unfolds a tale of which few men can say "such has been my experience." He says: "I have ridden on railroad trains nearly one-third of the time for twenty-five years, and during that time I have never even been off the rust (rails); neither have I ever been robbed of a dollar on a train. Also, I have never lost a hat, grip, umbrella or my temper on a railroad train."

The Dog Industry Hurts Railways

A correspondent of a prominent Southern daily paper, while discussing the reasons why the railroads south of the Ohio River receive such a small volume of business from the rural communities, puts the blame upon dogs. He says: We have been so busy growing dogs—so loyal to the dog industry—that we have not given attention to capitalizing our waste lands by growing sheep. I understand that there are a number of counties in Georgia which have more dogs than hogs, more dogs than milk cows, more dogs than sheep. While this, as I understand it, is true, there is not a market on earth where one can ship a carload of dogs and get fifty cents for them.

The dog as an assistant on the farm is useful—not alone useful, but a companion to the man who has to spend much of his time alone. But the dog in town is a nuisance and a menace to the health of the community. Nor is the danger of the dog in congested urban centers the worst phase of dog ownership. The real corroding effect of the dog in society—the mattress dog, the poodle, the greyhound and the terrier—is the squandering of affections on such pets when babies are such a wholesome thing to have about the place. Of course, the dog is easier cared for than a child.

2-8-0 Locomotive for the Lake Erie, Franklin & Clarion

Some three years ago General Charles Miller, chairman of the board of directors of the Galena-Signal Oil Company, and than whom few men are better known in the railway and industrial world, bought the Pittsburgh, Sommerville & Clarion Railroad. This was a small, run-down, coal road, having two connections, one with the Buffalo division of the Pennsylvania Railroad at Sommerville and the other at Sutton Junction with the Clearfield branch of the Lake Shore & Michigan Southern Railway, this particular part of the Lake Shore having been built by General Miller, who is yet its corporate president.

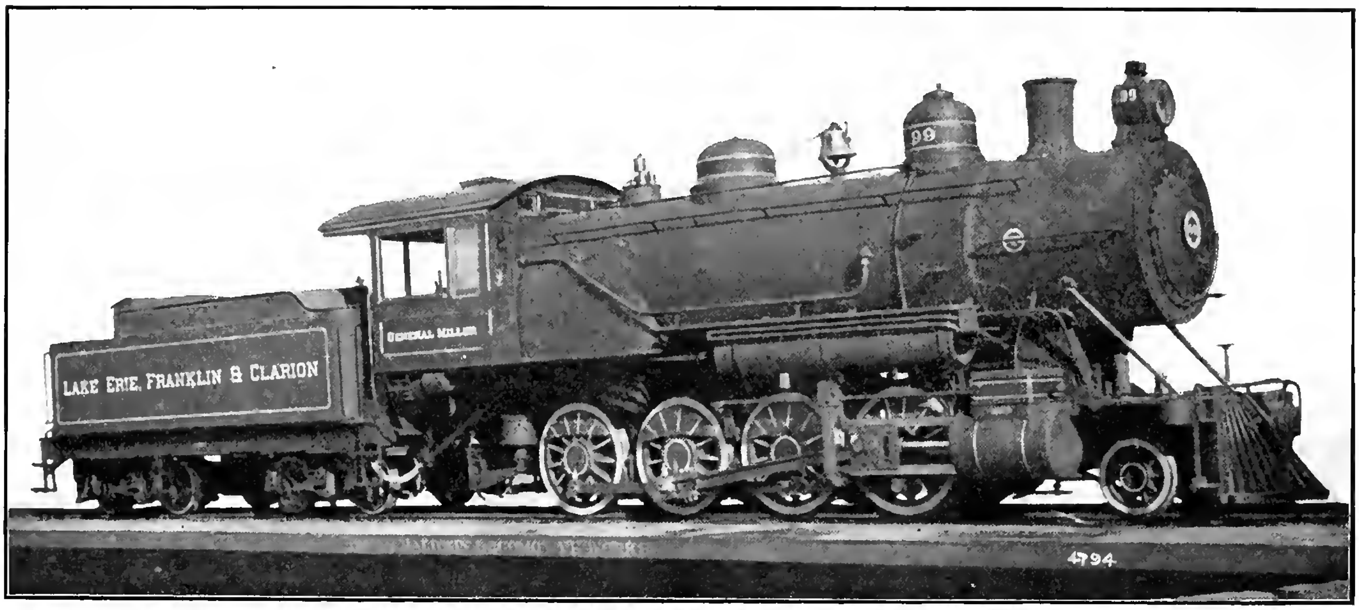
General Miller went about the rehabilitation of the Pittsburgh, Sommerville & Clarion Railway in the same energetic, businesslike manner that has characterized his entire business career. The company's principal assets were, its charter and land, with valuable unworked beds of coal.

Mr. J. T. Odell, a former vice-president of the Baltimore & Ohio and New England Railways, and a recognized authority on the reorganization and operation of railways, looked the proposition over and at a glance saw its latest potentialities, and through this medium one of the leading bankers of Pittsburgh became interested in providing funds for rehabilitation, extensions, etc. The earnings have almost doubled under the influence of the new ownership and management, and will reach new high levels as other mines are opened, thus increasing the tonnage of coal moved.

The track or permanent road has been rebuilt, as it were, new 80-lb. steel being provided in place of old 60-lb. badly worn rails, grades have been reduced, curves taken out, new shops and roundhouse built at Clarion and well stocked with modern machinery.

The largest locomotive on the line when bought by General Miller was an old, second-hand engine of about 18,000 lbs. tractive power. A new consolidation engine, that was thought to be a large one at that time, was bought in 1911. It had 32,600 lbs. tractive power, but on 2½ per cent. gradients could handle only a light train.

During October, 1913, the company was badly pushed for power, having two leased engines of limited capacity. The consulting engineer, in looking over the situation, found one of the leading locomotive builders offered to construct an engine to his specifications in forty-five (45) days and on acceptable terms of payment. The order was therefore placed with them, and in 43 days the engine was out ready for shipment, and in 47 days it was in service. The accompanying illustration shows the engine in question.



CONSOLIDATION TYPE LOCOMOTIVE FOR THE LAKE ERIE, FRANKLIN & CLARION RAILWAY.

W. E. Symons, C. E., Designer. Baldwin Locomotive Works, Builders.

Mr. W. E. Symons, a well-known consulting engineer, who designed the locomotive, does not claim any particular new features, but as a record of quick construction it reflects great credit on the builders.

The following are the general dimensions:

Gauge—4 ft. 8½ in.

Cylinders—22 ins. by 28 ins.

Boiler—Type, straight; diameter, 72 ins.; thickness of sheets, ¾ in.; working pressure, 185 lbs.; fuel, soft coal; staying, radial.

Firebox — Material, steel; length, 101 15/16 ins.; width, 66 ins.; depth, front, 69½ ins.; depth, back, 55½ ins.; thickness of sheets, sides, 5/16 in.; back, 5/16 in.; crown, ⅜ in.; tube, ½ in. Water space, front, 4 in.; sides, 3½ in.; back, 3½ in.

Tubes—Material, steel; thickness, No. 12 W. G.; number, 309; diameter, 2 ins.; length, 14 ft. 6 ins.

Heating surface—Firebox, 173 sq. ft.; tubes, 2,332 sq. ft.; total, 2,505 sq. ft.; grate area, 46.7 sq. ft.

Driving wheels—Diameter, outside, 54 ins.; diameter, center, 48 ins.; journals, 6 ins. by 10 ins.

Engine truck wheels—Diameter, 30 ins.; journals, 6 ins. by 10 ins.

Wheel base—Driving, 15 ft. 4 ins.; rigid, 15 ft. 4 ins.; total engine, 23 ft. 11 ins.; total engine and tender, 55 ft. 10¼ ins.

Weight—On driving wheels, 163,000 lbs.; on truck, front, 16,800 lbs.; total engine, 179,800 lbs.; total engine and tender, about 300,000 lbs.; tractive power, 40,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5 ins. by 9 ins.; tank capacity, 6,000 gals.; fuel, 10 tons; service, freight.

Longest Straight Railroad.

As is well known there are many long, level stretches of railroad on the American continent, but it may not be generally known that the longest stretch of railroad in the world without a curve is in New Zealand, where there is a distance of 136 miles in a perfectly straight line. This fact is remarkable when it is taken into consideration that New Zealand is one of the most difficult countries in the world for railroad construction, as it is very mountainous, necessitating sharp curves and very heavy grades.

Electrical Department

The Electrification of the Butte, Anaconda & Pacific Railway.

The Butte, Anaconda & Pacific Railway is, in many ways, the most remarkable example of steam road electrification in this country. Besides being the first 2,400-volt direct-current road, it is also credited with being the first steam road operating both freight and passenger schedules, to electrify its lines purely for reasons of economy. A number of steam railway electrifications have been made because of preemptory factors, such as terminal and tunnel operation or for rapid suburban service. This road, however, cannot be classed as an "enforced electrification," since no such special limitations have been the determining factors.

The first electric locomotives were put in service May 28, 1913, hauling ore cars between the East Anaconda yards and the smelter. During the first seven months of service, they made approximately 201,000 miles and hauled about 2,365,000 tons of ore.

The electrified lines of this system extend from the Butte Hill yard to the smelter, a distance of 32 miles. There are numerous sidings, yards and smelter tracks that have been equipped with overhead trolley, making a total of about 95 miles on a single track basis.

The Butte, Anaconda & Pacific Railway is essentially an ore-hauling road, the freight traffic from this source originating at the copper mines located near the top of Butte Hill. From the mines, the ore trains are lowered down the mountain a distance of 4½ miles to the Rocker Yards, located a few miles west of the city of Butte. At this point, new main line trains of approximately 4,000 tons are made up for transportation to the smelters at Anaconda. The main line division extends through a rough, mountainous country, a distance of about 20 miles, with grades as high as 0.3 per cent.

TWO UNIT ELECTRIC LOCOMOTIVE HAULING FREIGHT TRAIN.

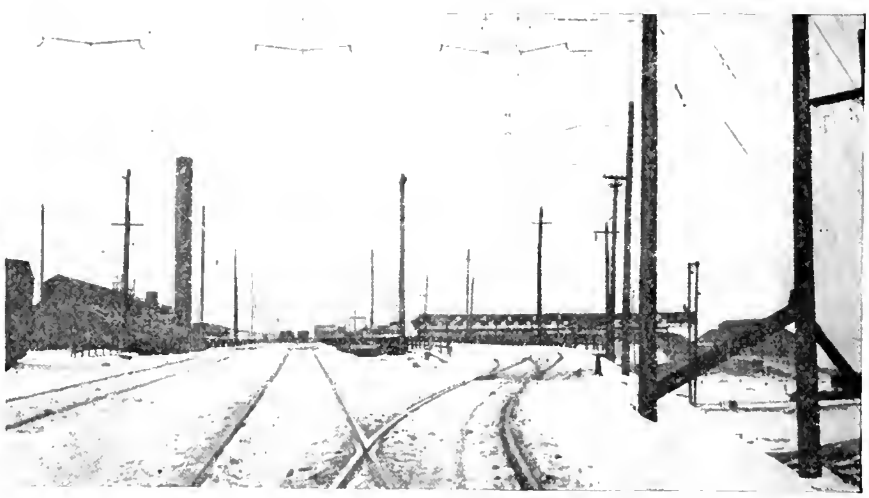
At East Anaconda, the main line trains are broken up and hauled up Smelter Hill to the stock bins, where each car is run over the scales and weighed. The shifting of cars in connection with weighing and subsequent delivery to the concentrators is done by single locomotives.

The eastbound traffic consists in returning empty cars to the mines and the transportation of copper ingot to the Butte Yards, where it is shipped over other roads to refineries.

The usual train make-up on the Butte Hill Line consists of thirty cars with a load of 2,000 tons. With two 80-ton locomotives a speed of 12 miles per hour is made on an approximate grade of 2.5 per cent. The average trolley voltage is 2,200. On the main line sixty cars with a load of 4,000 tons is hauled by the two 80-ton locomotives at a speed of 21 miles per hour, the grade being 3 per cent. The length of run on the Butte Hill Line steep grade is 4.6 miles, that on the main line with the smaller grade being a little over 20 miles.

Energy for the operation of the electric trains is purchased from the Great Falls Power Company, which is 130 miles from Butte. The power is transmitted at 102,000 volts, and is stepped down at the sub-stations where it is changed to 2,400 direct current by motor-generator sets. These motor-generators are three-machine sets consisting of one motor between two 1,200 v. generators, the latter being connected in series to give the 2,400 volts for the trolley.

The 2,400-volt switchboards for controlling these motor-generator sets are the first direct current boards to be constructed for this high voltage. In general, they are similar to the standard 600-volt types with increased insulation and special provision for interrupting the 2,400-volt current. The circuit breakers and switches are also arranged for remote control, and all apparatus on the panels is provided with ample insulation to insure safety to operators.



OVERHEAD CONSTRUCTION IN SWITCHING YARDS.

The 2,400-volt circuit breakers and switches are installed on separate panels above and back of the main panels, and are operated by connecting rods from

handles mounted on the front of the main switchboard.

The overhead construction is of the catenary suspension type. The copper trolley is supported by an 11-point catenary suspension from a stranded steel messenger cable.

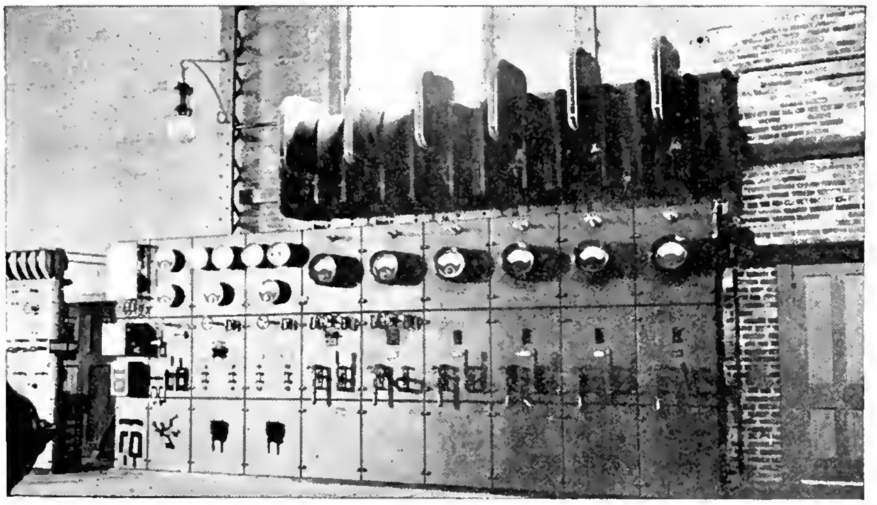
The locomotive equipment consists of seventeen 80-ton units, fifteen for the freight and two for passenger service. The freight locomotives are geared for slow speed and are operated in pairs for the main-line service. The maximum free-running speed is 35 m. p. h.

The two passenger locomotives are of the same construction as the freight units, but are geared for a maximum free-running speed of 55 m. p. h. A speed of 45 m. p. h. is made with three passenger coaches on straight level track.

The continuous tractive effort of a single 80-ton freight locomotive is 25,000 lbs. at 15 miles per hour. The maximum tractive effort for a period of five minutes is 48,000 lbs., based on a tractive co-efficient of 30 per cent.

These locomotives are of the articulated double-truck type, with all the weight on drivers. The cab contains an engineer's compartment at each end and a control compartment for control apparatus. This cab is of the box type, extending the entire length of the locomotive, and is provided with both end and side doors. The entire weight of the locomotive is carried on semi-elliptic springs suitably equalized.

The central channels forming a part of the underframe are enclosed and are utilized as a distributing air duct for the forced ventilation of the motors. The air is conducted through the center pins, which are hollow, into the truck transoms, and thence to the motors. The engineer's compartment at either end of the cab contains the operators' seat, controller, air brake valves, bell and whistle ropes, ammeter, air gauges, sanders and other control apparatus within immediate reach of the engineer.



2,400-VOLT D. C. SWITCHBOARD IN THE BUTTE SUBSTATION.

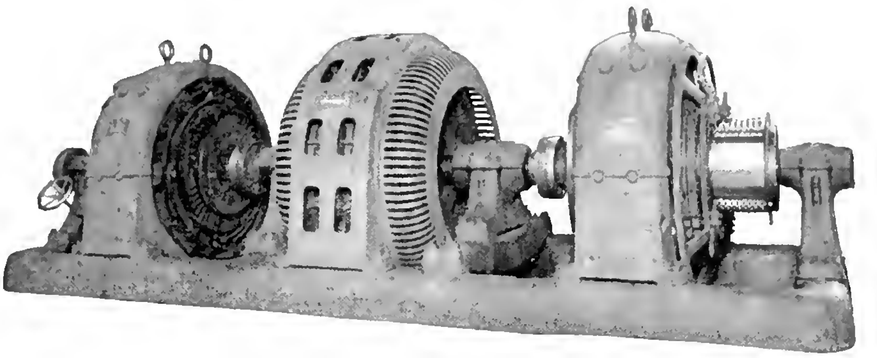
The contactors, reverser and rheostats, which are located in the central portion of the cab, are mounted in two banks running lengthwise of the compartment, and are conveniently arranged for cleaning, inspection and repair. All apparatus and circuits carrying 2,400 volts are thoroughly protected from accidental contact.

The motors are of the G. E.—229-A commutating pole type, wound for 1,200 volts and insulated for 2,400 volts. The gear reduction on the freight locomotive is 4.84 and on the passenger locomotive 3.2. The motors are connected to the driving wheels by twin gears.

The control equipment is Sprague-General Electric. Two of the 1,200-volt motors, of which there are four, are permanently connected in series. The 2,400 volts is not used to operate the switches or contactors, but 600 volts, which is obtained by means of a rotating machine known as a dynamotor. This machine, which is in reality a small motor, runs continuously on the 2,400 volts. The machine has two distinct sets of armature coils, each brought out to a commutator. One of these windings is designed for 1,800 volts, and the other for 600 volts. The current for operating the contactors and the compressor is taken from this 600-volt commutator.

The principal data and dimensions applying to the locomotives are the following:

Length inside of knuckles	37 ft. 4 in.
Length over cab	31 ft.
Height over cab	12 ft. 10 in.
Height with trolley down	15 ft. 6 in.
Width over all	10 t.
Total wheel base	26 ft.
Rigid wheel base	8 ft. 8 in.
Track gauge	4 ft. 8½ in.
Total weight	160,000 lbs.
Weight per axle	40,000 lbs.
Wheels, steel tired	46 in.
Journals	6 in. x 13 in.
Gears, forged rims, freight locomotives	87 teeth
Gears, forged rims, passenger locomotives	80 teeth
Pinions, forged, freight locomotives	18 teeth
Pinions, forged, passenger locomotives	25 teeth
Tractive effort at 30 per cent. coefficient	48,000 lbs.
Tractive effort at one hour rating	30,000 lbs.
Tractive effort at continuous rating	25,000 lbs.



ONE OF THE 1,000-KW., 2,400-VOLT D. C. MOTOR GENERATOR SETS IN THE SUBSTATION.

Report on Electrification by the Swiss Electrification Commission

The Swiss Electrification Commission recently made its report to the Swiss Government, which is of great interest to our railroad systems, for it relates to the possible electrification of nearly 2,000 miles of track. This report has considered the system best adapted for railroad service and has come out strongly for the single-phase system.

The various systems were considered, namely, the high voltage direct current, the three-phase system and the single-phase system. The latter has a pronounced advantage over the others. This report is extremely gratifying to many of the prominent engineers in this country who have helped to bring the single-phase system to its present standard. There are many railroads electrified by this system, the most notable being the New York, New Haven & Hartford, which now has approximately 200 miles of track electrified, and in the near future, when present work is completed, will have nearly 400.

A live wire way often be handled without inconvenience when standing on an India rubber mat, or on a dry wood floor, but it is a safe rule to avoid contact with any part of an electrical apparatus, without thoroughly understanding what one is doing. The symtoms of an electric shock are: stoppage or weakening of the action of the nerves, contraction and stiffening of the muscles, stoppage or weakening of the action of the heart.

Items of Personal Interest

Mr. Charles H. Schlacks has been elected president of the Hale & Kilburn Co.

Mr. B. D. Dehn has been appointed general foreman on the Boston & Maine, at Boston, Mass.

Mr. R. E. Wood has been appointed road foreman of equipment on the Rock Island, at Pratt, Kan.

Mr. W. G. Bierd has been appointed president of the Chicago & Allton, with offices at Chicago, Ill.

Mr. Geo. Gilmore has been appointed general foreman on the Detroit, Toledo & Ironton, at Delray, Mich.

Mr. W. T. Beery has been appointed master mechanic on the Union Pacific, with office at Omaha, Neb.

Mr. C. E. Test has been appointed general foreman on the Chicago Great Western, at Council Bluffs, Ia.

Mr. S. D. Page has been appointed general car foreman on the Bangor & Aroostook, at Milo Junction, Me.

Mr. H. Booth has been appointed road foreman of engines on the Delaware & Hudson, at Carbondale, Pa.

Mr. J. A. Turtle has been appointed master mechanic on the Union Pacific, with office at Denver, Colo.

Mr. C. W. Backe has been appointed chief engineer of the Nevada Northern, with offices at East Ely, Nev.

Mr. H. Mack has been appointed general foreman of the car department of the Santa Fe, at Bakersfield, Cal.

Mr. J. Fife has been appointed locomotive foreman on the Great Northern, with office at Casselton, N. D.

Mr. James Roberts has been appointed master mechanic on the Union Pacific, with office at Kansas City, Mo.

Mr. C. Burgess has been appointed signal supervisor on the Missouri Pacific, with office at Kansas City, Mo.

Mr. O. W. Wright has been appointed general foreman of the car department of the Santa Fe, at Richmond, Cal.

Mr. C. A. Gill has been appointed master mechanic on the Baltimore & Ohio, with office at Wheeling, W. Va.

Mr. F. G. White has been appointed signal engineer at the Chicago Great Western, with office at Chicago, Ill.

Mr. L. D. Freeman has been appointed mechanical inspector of the Seaboard Air Line, with offices at Portsmouth, Va.

Mr. R. A. Becker has been appointed supervisor of signals on the Grand Trunk System, with office at Montreal, Que.

Mr. E. G. Cromwell has been appointed motive power inspector on the Baltimore & Ohio, with office at Baltimore, Md.

Mr. L. Fisher, master mechanic on the Canadian Pacific, has been transferred from Souris, Man., to Brandon, Man.

Mr. Emil Marx has been appointed general foreman on the Chicago & Northwestern, with office at Winona, Minn.

Mr. J. F. Haddon has been appointed general foreman of the Toledo & Ohio Central, with office at Whitmore, Ohio.

Mr. W. Sinnott has been appointed master mechanic on the Baltimore & Ohio, with office at East Side, Philadelphia, Pa.

Mr. L. C. Ord has been appointed assistant master car builder on the Canadian Pacific, with office at Montreal, Que.

Mr. O. E. Stemp has been appointed traveling engineer on the Kansas City Southern, with office at Shreveport, La.

Mr. S. Butler, master mechanic on the Chesapeake & Ohio, has been transferred from Hinton, W. Va., to Clinton Forge, Va.

Mr. J. O'Neal has been appointed master car builder on the New Orleans, Mobile & Chicago, with offices at Mobile, Ala.

Mr. J. W. Highleyman has been appointed assistant master mechanic on the Union Pacific, with office at Cheyenne, Wyo.

Mr. W. G. Carlton has been appointed power superintendent on the New York Central Lines, with offices at New York, N. Y.

Mr. E. W. Denham, Jr., has been appointed special engineer on the Atlanta, Birmingham & Atlantic, with office at Atlanta, Ga.

Mr. D. R. Morris has resigned as signal engineer of the El Paso & Southwestern and will go with the Federal Signal Company.

Mr. F. H. Buchanan has been appointed signal inspector on the Pennsylvania Lines West of Pittsburgh, with office at Pittsburgh, Pa.

Mr. James Fahey has been appointed traveling engineer on the Nashville, Chattanooga & St. Louis, with office at Nashville, Tenn.

Mr. W. J. Brooks has been appointed foreman of locomotive repairs on the Chicago & Alton, at Brighton Park, P. O., Chicago, Ill.

Mr. G. W. Robertson, master mechanic on the Chesapeake & Ohio, has been transferred from Lexington, Ky., to Hinton, W. Va.

Mr. J. W. Johnson has been appointed general car foreman on the Atlanta, Birmingham & Atlantic, with office at Fitzgerald, Ga.

Mr. E. J. Creel, general foreman of the locomotive department, has been transferred from Painesville, Ohio, to Chicago Junction, Ohio.

Mr. M. F. Cox has been appointed assistant superintendent of machinery of the Louisville & Nashville, with offices at Louisville, Ky.

Mr. F. W. Boardman, assistant master mechanic on the Baltimore & Ohio, has been transferred from Philadelphia, Pa., to Cumberland, Md.

Mr. D. H. Watson, assistant master mechanic on the Baltimore & Ohio, has been transferred from Cumberland, Md., to Keyser, W. Va.

Mr. T. W. Younger, superintendent of motive power on the Southern Pacific, has been transferred from Portland, Ore., to Sacramento, Cal.

Mr. F. R. Pennefather has been appointed master mechanic of the Manitoba division of the Canadian Pacific, with office at Winnipeg, Man.

Mr. J. Dickson, general master mechanic on the Spokane, Portland & Seattle, has been transferred from Vancouver, Wash., to Portland, Ore.

Mr. W. A. Ford and Mr. J. J. Malloy have been appointed signal inspectors on the New York, New Haven & Hartford, with offices at New Haven, Conn.

Mr. Wm. Naylor has been appointed road foreman of engines for the Northern district of the Chicago & Alton, with headquarters at Bloomington, Ill.

Mr. M. P. Hoban, road foreman of engines on the Baltimore & Ohio, will confine his duties to the territory between Troy and Cincinnati, with office at Dayton, Ohio.

Mr. C. F. Norman, formerly road foreman of engines on the Rutland, at Rutland, Vt., has been appointed general foreman on the Ogdensburg division, with headquarters at Malone, N. Y.

Mr. H. D. Holden has been appointed traveling engineer on the Rutland, south of Albany. Mr. Holden was formerly a locomotive engineer on the Rutland and his promotion is warmly approved.

Mr. D. R. Niederlander has been elected president of the Adreon Manufacturing Company, St. Louis, Mo. This company also maintains a branch at Montreal, with Mr. O. N. Meissner as representative.

Mr. C. J. McMaster, formerly master mechanic on the Rutland, at Malone, N. Y., has been appointed chief inspector of motive power and car departments on the same road, with office at Rutland, Vt.

Mr. J. Cools has been appointed supervisor of locomotive operation on the Erie,

with office at Jersey City, N. J., and Mr. J. Cunneen has been appointed to a similar position on the same road, also at Jersey City.

Mr. W. B. Kilgore has been appointed road foreman of engines on the same road, with jurisdiction between Troy and Toledo and office at Lima, Ohio. The position of assistant road foreman of engines at Lima has been abolished.

Mr. Scott R. Hayes has been appointed assistant to the president of the New York Air Brake Company. Mr. Hayes has been with the Railway Steel Spring Company, New York, since its organization, and resigns to go to the New York Air Brake Company.

Mr. George W. Tompkins, will assume the duties of car foreman of the repair track of the Spokane, Portland and Seattle railway company in addition to his present work, with the car foreman, the former position previously held by Mr. E. Grant being abolished.

Mr. W. H. Davis, formerly air brake superintendent and road foreman of engines in the Northern district of the Chicago & Alton, has resigned to become general air brake inspector on the Oregon Short Line, with headquarters at Salt Lake City, Utah.

Mr. M. Riddle has been appointed general manager of the Florida East Coast Railway, with office at St. Augustine, Fla. Mr. Riddle entered the service of Atlantic Coast Line in 1891, and has filled the positions of roadmaster, superintendent, assistant chief engineer, and general superintendent.

Mr. L. J. Leary has been appointed general foreman of the car department on the Baltimore & Ohio, at East Side shops, Philadelphia, Pa., and Mr. E. D. Morrison has been appointed to a similar position on the same road at Cumberland, W. Va., and Mr. J. F. Sommers, Jr., has been appointed to a similar position on the same road at Garrett, Ind.

Mr. M. E. Martz has been appointed general foreman of the locomotive department on the Baltimore & Ohio, at Somerset, Pa., and the following have been appointed to similar positions on the same road: Mr. J. K. Milholland, at Grafton, W. Va.; Mr. F. S. Torback, at Mt. Clare shops, Baltimore, Md., and Mr. C. B. Van Blarcum, at Columbus, Ohio.

Mr. J. L. Allavie has been appointed traveling engineer on the Union Pacific, with office at Omaha, Neb., and the following have been appointed to similar positions on the same road: Mr. W. R. Gilpin, at Evanston, Wyo.; Mr. J. F. McNally, at Denver, Colo.; Mr. B. E. O'Neil, at Cheyenne, Wyo., and Mr. H. E. Richards, at Ellis, Kans.

Mr. John Dickson has been appointed master mechanic of the Spokane, Portland & Seattle Railway, Oregon Trunk Railway, Oregon Electric Railway and United Railways, with headquarters at Portland, Ore. The office of superintendent of motive power, which A. C. Adams recently resigned to engage in other business, has been abolished.

Mr. H. A. Boomer has been appointed general manager of the Lake Erie & Western, with offices at Indianapolis, Ind.

J. T. ANTHONY.

Mr. Boomer has had a wide experience on some of the western roads, and has filled many positions from station agent to general superintendent. From 1896 to 1903 he was division superintendent on the Lake Erie & Western at Lafayette, Ind., and from 1903 to the date of his appointment as manager he acted as assistant general superintendent of the same road. He is a native of Philo, Ill., and is now in his fifty-first year.

H. D. SAVAGE.

Mr. A. L. Mills has been appointed general manager of the St. Louis, El Reno & Western, with offices at Ft. Smith, Ark. Mr. Mills has had an extensive engineering experience in some of the leading Western railroads. He entered railway service in 1879 as assistant engineer on the Santa Fe, since which time he has been superintendent of construction on the California Southern, and latterly chief engineer on the same road, also chief engineer on the Toledo, St. Louis & Kansas City, and general superintendent on the same road from 1898 to the present year. He is a graduate of the Massachusetts Institute of Technology, and is a native of Boston, Mass.

Master Howard Elliott, son of Mr. Thomas Elliott, a distinguished attorney, and who is attending the classes at the academy at Roxbury, Idaho, is keenly interested in railroad matters. The boy called attention to a dangerous switch that would have very possibly derailed the next train, and has received high praise from the local railroad authorities. He is already an expert telegrapher, and bids fair to take a high place in the engineering profession, and may be a worthy successor to his distinguished namesake, the president of the New Haven Railroad.

Mr. Wm. Pickersgill, at present locomotive superintendent of the Great North of Scotland Railway, has been appointed to the head of the mechanical department of the Caledonian Railway, succeeding Mr. John F. McIntosh, retired. Mr. Pickersgill is a native of Crewe, England, and served an apprenticeship as machinist in the Great Eastern Railway repair shops at Stratford, London, rising on that system to be assistant locomotive superintendent. In 1894 he was appointed head of the rolling stock department of the Great North of Scotland Railway, which he now leaves.

Mr. J. T. Anthony has been appointed assistant general eastern sales manager of the American Arch Company. He was born February, 1883. Graduated at Georgia Tech. in 1902. Was engaged in textile manufacturing for four years. Entered the service of the Atlantic Coast Line Railroad in 1906. Entered the service of the Central of Georgia Railway January, 1907, in the motive power department. He took the position of combustion engineer with the American Arch Company in January, 1912, and was made assistant to president in January, 1913, which position he held until March 1, 1914, when he was appointed to his present position.

Mr. Harlow D. Savage has been appointed general eastern sales manager of the American Arch Company. He was born at Memphis, Tenn., April 16, 1880. He is a graduate of the Kenyon Military Academy, and is at present military aid to the Governor of Kentucky. He has been connected with the Ashland Fire Brick Company from 1907 to the present year. He is a director of the Clinton Mining Company, Ashland Fire Brick Company, and Charleston Hardware Company; and is also president of the

German Mining and Manufacturing Company. He is a member of the Institute of Mining Engineers and president of Refractories Mining Association. His offices are at 30 Church street, New York City.

Mr. J. R. Crowley has been appointed general foreman on the Atlanta, Birmingham & Atlantic, with office at Manchester, Ga., and the following have been appointed to similar positions on the same road: Mr. E. C. Hanse, at Talladega, Ala.; Mr. C. L. Megalis, at Fitzgerald, Ga., and Mr. C. W. Rhinehart, at Brunswick, Ga.

Mr. J. B. Nessle, general coal and ore agent on the New York Central Lines, having been transferred, the office is now abolished and all matters pertaining to coal, coke and ore traffic will hereafter be handled by Mr. H. M. Griggs, general coal and ore agent, whose headquarters will be moved from La Salle street station, Chicago, to the Brotherhood of Locomotive Engineers' building, Cleveland, Ohio.

Mr. J. G. Koppell has been appointed mechanical electrical superintendent of Bascule Bridges on the Canadian Pacific, with headquarters at Sault Ste. Marie, Ont. Mr. Koppell is a graduate of the Imperial School of Technology at Libau, Germany, and served as electrical mechanic in the government yards in that city. He worked some time in London, England, and moved to Montreal, Canada, six years ago, and worked in the Montreal Locomotive Works. Mr. Koppell attended the electrical school in Montreal and also graduated in the class of English literature, and has contributed to engineering periodicals. He is possessed of inventive genius of a high order, and his contributions to Railway and Locomotive Engineering have been warmly appreciated and extensively copied by the engineering press. He has been acting for some time as power house construction foreman in the Angus shops, and enters his new position with eminent qualifications and the good wishes of all who have the honor of his acquaintance.

J. G. KOPPELL

Mr. W. R. Scott has been elected vice-president of the Southern Pacific Company, and assumes the title and responsibilities in addition to his position as general manager in charge of operation and maintenance. He succeeds to the vice-president's office in place of Mr. E. E. Calvin, who has resigned to accept service with another company. Mr. Scott has had a wide experience in a number of Western railroads and entered the service of the Southern Pacific in 1903 as assistant superintendent of the Sacramento division, and was latterly superintendent of the Salt Lake division. In 1907 he was general superintendent of the Northern division. He was appointed general manager in July, 1912.

W. R. SCOTT

Mr. J. M. Davis, who has been assistant general manager of the Baltimore and Ohio, Southwestern-Cincinnati, Hamilton and Dayton lines since January 1, 1914, has been advanced to general manager, succeeding Mr. W. C. Loree, resigned. The appointment is effective at once, as announced by vice-president A. W. Thompson, the chief operating officer of the Baltimore and Ohio system. The new general manager began his railroad career in the Southwest and was later employed by the Great Northern, Erie, Union Pacific and Southern Pacific lines. Prior to entering Baltimore and Ohio service Mr. Davis was general superintendent of the Southern Pacific Railroad, at San Francisco.

Mr. W. S. Murray has been appointed by the New York, New Haven & Hartford Railroad Company to be consulting engineer in general charge of all electrical engineering and construction, reporting to President Hustis, with offices at New Haven. Mr. Murray, following the substantial completion of the construction of the system for complete electrical operation west of New Haven, will enter into closer relations with the railroad company. His jurisdiction will hereafter be extended to also include the electrical features of operation in addition to electrical construction. He will continue with the firm of McHenry & Murray in general consulting practice as before.

Mr. John F. McIntosh, M. V. O., who has been for 52 years in the service of the Caledonian Railway of Scotland, most of this time as locomotive superintendent, has decided to retire next May. Mr. McIntosh joined, at Arbroath, the mechanical headquarters of what was then the Scottish North Eastern Railway, in 1862. A few years later, when he had become an engine driver on the Bemic branch, he jumped off his engine to help in stopping some runaway cars, fell and had his right arm cut off. John regarded that misfortune as likely to end his career in the locomotive department, but it really improved his prospects. When he recovered from the injuries he was appointed locomotive inspector, a position similar to that of our road foreman of engines, and he displayed so much energy and ability that he was gradually advanced till in 1895 he became locomotive, carriage and wagon superintendent, the position he is about to relinquish. Mr. McIntosh was in the habit of riding on the royal trains on their runs over the Caledonian Railway. In October of last year King George honored Mr. McIntosh by creating him a member of the Royal Victorian Order.

JOHN F. McINTOSH.

George Westinghouse—An Appreciation of His Life Work

By ANGUS SINCLAIR

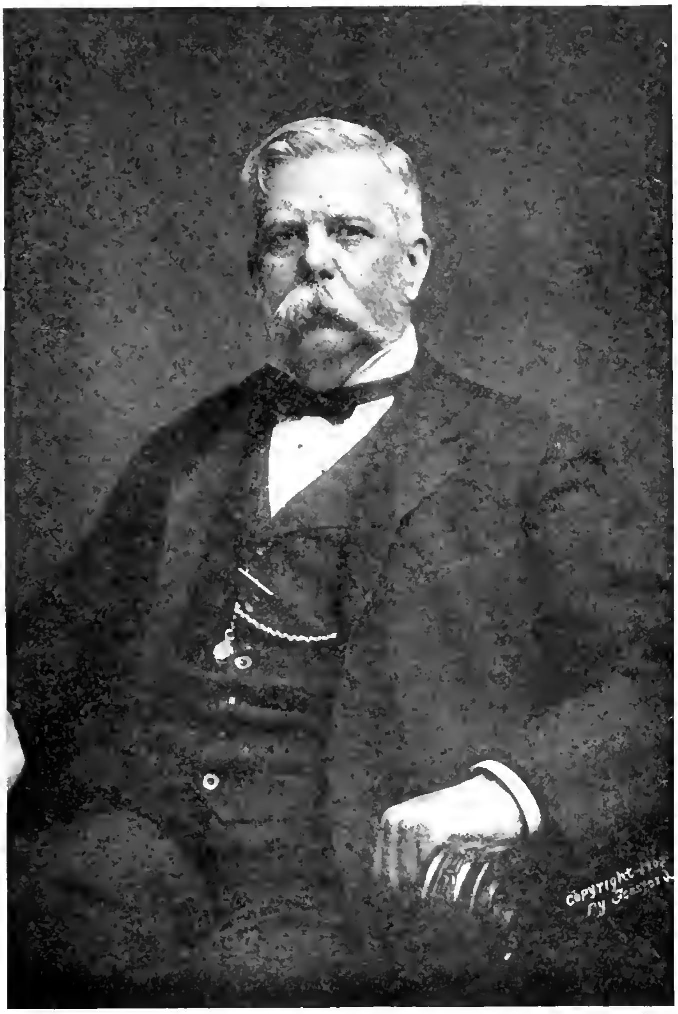
In studying the lives of the great men whose labors have contributed to the glory of this industrial era, the name of George Westinghouse, who passed away on March 12, stands out conspicuous above all others. Familiarity with the achievements of all modern inventors, has convinced me that George Westinghouse was the greatest inventor of our time, and that his labors have been productive of greatest benefit to mankind of any man who has tried to increase the comfort and safety of modern life. The Westinghouse Air Brake is an invention which will be used as long as railway trains are operated. It is the greatest life saving invention ever given to the world. By the invention of the railway train air brake George Westinghouse has been the means of saving more life and preventing more human misery than the most successful military commander has ever succeeded in blotting out, or inflicting.

Mr. Westinghouse was born near Schenectady, N. Y., sixty-eight years ago, and comes of an engineering race, his father having been owner of a machine shop in Schenectady, where George worked for years and acquired the sound ideas concerning mechanism always displayed in the work he performed. His brother Herman is inventor of a single-acting steam engine that has met with extended appreciation.

The passion for inventing touched George early in life, for when he was only seventeen years old he invented a car replacer which was a success, and shortly afterwards he devised a novel form of rotary steam engine, a line of invention that held his attention for many years.

When the Civil war broke out George Westinghouse entered the army as a volunteer but afterwards exchanged to the navy, where he served till the end of the war. Improved facilities for stopping railroad trains had been occupying his mind for years, and his ideas culminated in 1868 when he secured a patent on what was known as the straight air brake. That was a great step in the proper direction, but the compressed air was conveyed direct from the engine to the various brake cylinders under the cars, which did not provide against accidents. When any accident happened to the train pipe under that system the brake was rendered useless.

Mr. Westinghouse recognizing that defect proceeded to invent the mechanism necessary to render the air brake automatic. The acting principle of this improvement was the triple valve. To the writer this triple valve was the most amazing invention he had ever known. A comparatively simple apparatus attached to an air auxiliary reservoir located under each car enables the engineer to apply the brakes to every car on a train no matter how far away they may be from the engine. Any accident which fractures the train pipe, serves to apply all the brakes on the train automatically.



GEORGE WESTINGHOUSE,
The Inventor of the Air Brake.

Designing the automatic brake was a great feat of inventive genius, but many other important improvements were made by Mr. Westinghouse which enables the brake to control or stop a 70-car train as smoothly as it does the local of 5-cars. But Mr. Westinghouse did not confine himself to brake mechanism. Every apparatus calculated to promote safety in railroad operation received his attention. He also worked successfully in the electrical field and one of his latest achievements was a geared turbine system for the propulsion of ships.

In acknowledgement of his great achievements, the highest honors of technical societies and institutions of Europe and America were bestowed upon Mr. Westinghouse. As recently as last December he received from the principal engineering society of Germany the celebrated Grashof gold medal. His alma mater, Union College, of Schenectady, conferred upon him the degree of doctor of philosophy. He was decorated with the order of the Legion of Honor, with the order of the Royal Crown of Italy, with the order of Leopold of Belgium. He was the second recipient of the John Fritz medal. He received the degree of doctor of engineering from the Koenigliche Technische Hoschule of Berlin, Germany. He was an honorary member of the American Society of Mechanical Engineers, of which body he was also president in 1910. He was one of the two honorary members of the American Society for the Advancement of Science. He was an honorary member of the National Electric Light Association of America. He was awarded the Scott premium and medal by the Franklin Institute of the State of Pennsylvania. He received the Edison gold medal for meritorious achievements in the alternating current system of electrical distribution.

Mr. Westinghouse was connected with a large number of industries at home and abroad, many of which bore his name. The employees numbered over 50,000.

Mr. Westinghouse was a most genial and enjoyable gentleman with a high sense of justice and fairness towards every person connected with himself or his enterprises. His was the first great manufacturing establishment in America to grant the employees a weekly half-holiday. He founded many manufacturing companies in this country and abroad.

OBITUARY.

John C. Stuart.

John C. Stuart, until a few months ago vice-president and general manager of the Erie Railroad, died at his home in Garden City, Long Island, on March 4, of a complication of diseases. Born in 1861 and given an ordinary school education, John C. Stuart was ambitious to make his way in the mechanical world and entered a machine shop for the purpose of learning the machinist trade. Like many other humble aspirants to engineering, John found that his work in the machine shop was the hardest kind of drudgery, being confined mostly to cleaning castings. That work not suiting his ambition, he began preparing himself for something with better prospects and entered railroad life as a telegraph operator.

His advancement in railroad life was rapid, for he entered the service of the C. & N. W. Railway in 1880, and in 1888 we find him chief train dispatcher on the Galena division. Two years later he was made assistant superintendent, then two years later made superintendent. A few years later he was made general superintendent of the whole system of the Chicago, St. Paul, Minneapolis & Omaha Railway. He was the type of man whose work is his hobby, and from the start he devoted close study to the various phases of railroad business through which he was likely to increase his usefulness.

When Mr. F. D. Underwood became president of the Baltimore & Ohio Railroad, he looked around for help among the energetic railroad men of the West, and Mr. Stuart was appointed in 1890 general superintendent of the middle division then afterwards was made general superintendent of the whole line.

He went to the Erie in 1903 as general superintendent of the Ohio division. A year later he was made general manager of the Erie Railroad, and in 1910 was elected vice-president. When his health failed six month ago so that he could not attend to his other duties, he was made assistant to the president.

Mr. Stuart was also vice-president and general manager of the New York, Susquehanna & Western Railroad Company, and a director of the Bergen County Railroad Company, the Erie & Black Rock Railroad Company, the Hackensack & Lodi Railroad Company, the Lake Keuka Navigation Company, the Middletown, Unionville & Water Gap Railroad Company, the Niagara River & Erie Railroad Company, the Southern Tier Development Company and the Suffern Railroad Company.

John C. Stuart was of Scotch Highland stock, his ancestors having affiliated with the Dukes of Athol. Some of them were out with Prince Charlie in 1745 and fought in the disastrous battle of Culloden along with the Murrays of Athol.

John C. Stuart was a fast friend, a genial companion, with a keen sense of humor, and an exceptionally good business man. An address which he delivered before the Interstate Commerce Commission calling for justice to railroad interests was one of the most striking appeals ever made before the commission.

JOHN C. STUART.

He was a member of the St. Andrew's Society of New York, and took a warm interest in the benevolent work done by that great Scottish society.

William K. Austin.

Mr. William Kerr Austin, a mechanical engineer, the inventor of a rotary engine and numerous mechanical devices, died at his home in Brooklyn last month. He was a native of Belfast, Ireland, and had been over forty years in America. He was a director of the Union Planing Mills of South Brooklyn, and had perfected many mechanical devices used in his business. He was a prolific writer on engineering and economic subjects, and was especially interested in better working conditions.

James Gresham.

Mr. James Gresham, whose name is closely associated in the British Isles with the manufacturing of injectors and other locomotive appliances, died in January last. Mr. Gresham was a member of the leading engineering societies of Great Britain and a justice of the peace. He perfected many improvements in the smaller boiler attachments, many of which are in use on British locomotives.

NOTES.

Johns-Manville Co. Extension.

The necessity for larger space and better facilities to handle their increased business compelled the Indianapolis, Ind., and Louisville, Ky., branches of the H. W. Johns-Manville Co. to seek larger quarters. The new address of the Indianapolis branch is 408-410 North Capitol avenue, that of the Louisville branch, 659-661 So. Fourth avenue. Both of these branches will include ample warehouse accommodations, in addition to show rooms for the display and sale of this firm's varied line of asbestos roofing, pipe coverings, insulating materials, lighting fixtures, automobile accessories, etc.

The Winnipeg Electric Railway Company, of which Sir William Mackenzie is president, has engaged the J. G. White Engineering Corporation to complete surveys, explorations, designs, plans and estimates for a large hydro-electric development near Winnipeg, Canada, which ultimately will be considerably in excess of 100,000 horsepower and which initially will be for 40,000 horsepower. Work on the surveys and designs is to be started immediately and completed as rapidly as possible.

The Chicago Car Heating Company has recently opened a branch office and factory at No. 61 Dalhousie street, Montreal, Canada, to take care of its rapidly increasing business in the Dominion. A. D. Bruce, formerly purchasing agent of the company at Chicago, is in charge. Mr. Bruce is a native of Guelph, Ontario, but has been connected with the Chicago Car Heating Company in Chicago for the past five years.

The Technology School of Atlanta, Ga., has opened a night school which has 200 students, most of them ambitious to learn engineering. The railways in the South give liberal encouragement to graduates of engineering and technical schools.

The offices of Mr. Charles R. Long, Jr., & Co., and the headquarters of Mr. Harry Vissering & Co., Inc., at Chicago, have been removed from the Great Northern building to the sixteenth floor of the Lytton building.

Mr. William Sloane Accles, European manager of the Niles-Bement-Pond Company, with offices at 25 Victoria street, London, England, arrived in New York last month, on a short visit to the United States.

The Central Railway Supply Company, of Chicago, has moved to 176 North Market street.

He Will Not Attend the Convention.

"It is drawing towards convention time," said the Rambler to Master Mechanic Name the other day, "and I hope you will attend the meeting."

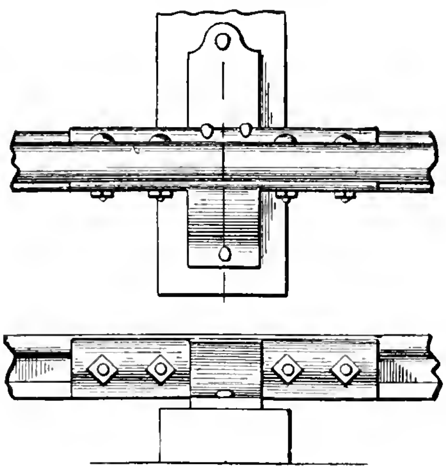
"What is that you say, Mr. Rambler?" exclaimed the head of the mechanical department, N. G. Railroad. "Have you been through these shops and suppose that I could go away from here for two weeks and let everything go to wreck and ruin? Why, sir, I have not been but three days away from this place in fifteen years, and that was on the company's business."

"Go to the convention, indeed," repeated Mr. Name two or three times, as if weighing and relishing the absurdity of the idea. Then, as if roused to action, he jumped up and said: "Come and I'll show you what I've got to do instead of going to your convention."

Then he rushed me the second time, as fast as littered floors would permit, through the shops and roundhouse, and pointed out the miserable condition of many engines and gave me the assurrance that when other master mechanics were enjoying themselves at Atlantic City he would be doing everything that mortal man could perform by personal supervision, to get some of these engines hurried through the shop. After he had fatigued himself expatiating upon the difficulties of making performance keep pace with the demands of the repairing service, he triumphantly inquired: "Now, do you think it likely that I shall go to the convention?" and I conscientiously answered, "No."

As I walked through the shops and noticed that most of the tools were run far below the economical speed, and that the cuts taken were scratches beside the cuts common in shops that made little claim to being progressive and up to advanced practice, I could not help thinking that the company might be decidedly the gainer if the master mechanic took a couple of weeks annually to see what was going on elsewhere and how other shops were managed. I also thought that if Mr. Name had been in the habit of annually talking about the managing of the mechanical department of a railroad with men engaged in the same occupation, he w uld have received suggestions which would have benefited himself and the company which he tries so zealously to serve. A natural result of such wider intercourse might have been the convincing of this man that he might safely and judiciously leave certain details of the shop management to be carried on by subordinates. That would have given him time to attend to duties of greater importance than that of being his own shop foreman.

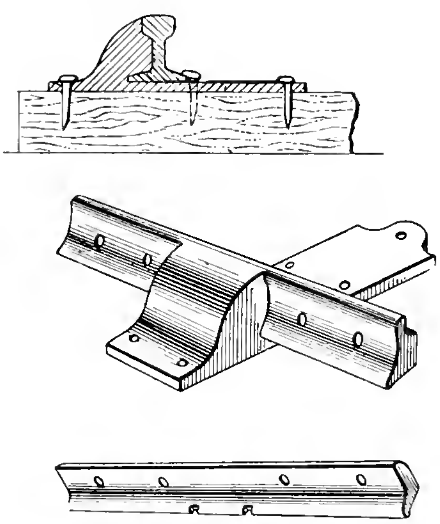
Mr. Name is a representative man of a rapidly diminishing class, who take credit to themselves for taking no holidays and attending personally to every detail of the work going on. That sort of egotism is very comforting to those who indulge in it; but in nearly every case it is unfortunate for the company they serve. I never yet found the head of the mechanical department so overwhelmed with business that he could not go away for a holiday, but what the company's business was mismanaged. It is the small calibre men, whose business is too great for their capacity, that cannot find time to attend conventions, railroad club meetings and other gatherings of their class, where they are likely to learn things that will stimulate them to push into the line of progress.



MUSGROVE RAIL JOINT.

New Rail Joint.

Very favorable reports are being made on a new type of rail joint that is being tested on several railroads in the vicinity of New York, including the Central Railroad of New Jersey and the Staten Island Transit Railway, a subsidiary branch of the Baltimore & Ohio.



SECTION AND ISOTHERMIC VIEW OF MUSGROVE RAIL JOINT.

As is shown in the accompanying illustrations, the object of the invention is to provide a rail fastener and brace embodying such a construction that the necessity of employing angular bars and fish plates is obviated and one which is adapted to tightly hold and support rails and to withstand the great strain imposed on the center rail at a curve. It also serves as a tie plate and is claimed to provide a much safer track and prevent breaking, turning over and spreading of the rails. The rail joint being all in one piece lessens the danger of the nuts and bolts becoming loose and will also check creeping of the rails. It also provides for the completing of the electrical circuit through the rails which is necessary in a block-signal system, without necessitating the use of a wire connection.

Amber and Magnetism.

Among the learned philosophers of Greece who flourished about 300 years before our era was one named Theophrastus, who was a leader among his class and studied botany so effectually that he wrote a History of Plants that was the leading authority on that subject for centuries. One day this Theophrastus was toying with a piece of amber and having accidently rubbed it on his sleeve noticed that the amber attracted small articles such as wood shavings, feathers, etc. The philosopher proceeded to experiment with amber and popular opinion invested it with many valuable properties that it never possessed.

Magnetic iron was discovered about the same time and soon became the object of persistent experiment, the mariner's compass being the most useful discovery. Learned men of leisure continued to experiment with magnets and amber and their work, although of little direct value, paved the way to the development of magnetism and of electricity.

The imagination of ancient savants conjured up some curious properties as being possessed by magnets, such as being effective in the cure of diseases, a belief that was by no means confined to the ancients, for we have found even in the twentieth century people drinking magnetised water as a certain cure for certain complaints. Many of the ancients believed the magnet to be a sure love philter, and that it lost its power when rubbed with garlic but was restored when annointed with goat's blood.

An electrical genius whose forte is figures, says that a flash of lightning has the force of thirteen thousand horsepower. We wonder if this expert used the same basis of calculation as the school boy did, who figured that the hind leg of a mule that kicked him weighed seven thousand pounds.

The only man who should not advertise is the one who has nothing to offer the world in way of service or commodity.

German Industrial Training.

All the world has been made familiar with the expression "a royal road to learning," which means acquiring learning without labor. That has been often tried, but always ended in disappointment. Most people now admit that there is no royal road to academic learning; but of late years the impression has been circulated that the mechanic arts may be acquired by some easy process that involves no labor. Many of the trade schools that are industriously exploited, are merely attempts to learn trade without labor.

Of late years those connected with mechanical industries have been advocating the imparting of more scientific knowledge to apprentices, and trade schools have tried to perform the required work, but in most of them the art or handiwork skill has taken a secondary place, when it ought to be held of the greatest importance. Some railroad companies and industrial concerns have adopted the practice of giving technical education to the apprentices working in shops and factories and exceedingly satisfactory results are being achieved; but these concerns supply only a small proportion of the training necessary to rising workmen.

We learn from an article contributed to *Harper's Magazine* that the Munich (Germany) schools have worked out the system of industrial training which undoubtedly leads the world, because it is based on demonstration teaching in workshops. Dr. George Kerschensteiner, a member of the Reichstag, has fought a long fight to bring the Munich schools to their present splendid condition. Today Munich has 52 trades for which teaching is given, and is enlarging her present plans and facilities. Seven fine buildings about the town give space for classes and for well-equipped shops, where some 10,000 boys and about the same number of girls receive instruction. Practical men direct almost all the subdivisions of the commercial, painting and decorating, building, printing, mechanical-engineering, wood and metal working trades, besides miscellaneous ones like shoemaking, wig-making and confectionery manufacturing. These teachers are often taken from their trade and taught to teach. Dr. Kerschensteiner would rather make a teacher out of a plumber than convert a teacher into a man of tools, although, when occasion arises, suitable teachers in the trade itself not being available, academically-informed men are given furloughs in order to enter into actual practice for a sufficiently long time to master it. Some of the best teachers are part-time men who are eminent in their various lines, as, for instance, commercial photography and sculpture. The boy who works at a craft like stucco-making may get part of his instruction under an artist instead of an artisan.

The foundation of trade education is laid in the day school. At about ten years of age, boys planning to enter the professions customarily separate from the others, to go then or later into higher schools. It must be noted that this is in reality a separation of social classes, and there is little further contact between the groups. Those not planning for "higher" education, those numerous needy "others" who constitute the real human school problem, are then grounded in the use of tools, in carpentry, metal-work, the rudiments of mechanics and of gardening; or, in the case of girls, commercial study, needlework, housekeeping. In the beautiful new Sieboldstrasse common school there are excellent workrooms for all these subjects, and, in addition, fine bakeries with practical modern ovens, attractive garden-plots where even horticulture is begun, and the *concierge's* chickens to serve as an experimental chicken farm. The boy who in his last elementary year really knows what he wants to do frequently obtains his apprenticeship by himself, or in answer to a request from an employer, who applies to the head teacher for a certain kind of helper. Description of jobs, with or without pay, or perhaps even requiring a premium, are posted as bulletins in this school. The parents, possibly the teacher, and well-classified information about occupations, based on the excellent census of trades and employment, are depended upon to help the boy decide.

Gum Chewing in the South.

One severe winter day we passed south through Ohio in the midst of violent snowstorms making toward the Ohio River southward bound. The change of weather encountered in a few degrees was astonishing. Kentucky had practically no trace of the snowstorms and we moved quietly into summer weather, which was reached in all its glory at Atlanta.

In traversing the Southern States the reflection naturally comes, What a glorious country for stock raising! But farm animals were very little in evidence. In a run of 400 miles we saw only one animal of the cud chewing kind, a solitary cow sheltering itself among brush as if hiding from people wishing to draw her milk. But if cud chewing animals were scarce, gum chewing humans were painfully numerous. It seemed that every man and woman in the train were actively using their jaws, the men on tobacco and the women on gum. The following cutting from the *Atlanta Constitution* would indicate that the promotion of gum chewing was encouraged by the highest authorities:

"L. W. Berkstein, who admits that he is a crook, but swears that he is an honest crook, is being held at the police station on the charge of suspicion. He left this city on the 23d day of January to pose as a deaf-and-dumb chewing gum salesman. He toured all the large cities of South Carolina, Savannah and Augusta, and has permits he secured from the mayors of these towns to sell his gum.

"While in Columbia, he entered the hall of the legislature of the State, and tells the story that he stopped the legislative proceedings while he sold his gum to the legislators.

"After touching the legislature for $40, he then called on Governor Cole Blease, waiting three hours to see him. When he was ushered into the governor's office, through the compassion of his kind-hearted secretary, he states that he wrote on his pad that he liked the governor. He tells the tale that before he left the governor's office he had "skinned" his honor of a five-dollar bill."

Work of Coming Conventions.

The Committee on Subjects for Investigation by the members of the Railway Master Mechanics' Association made certain that the next convention should have the opportunity of dealing with a great variety of subjects, for it recommended to the Executive Committee the consideration of no less than fifty-one subjects. Considering the way in which the discussion of railroad mechanical subjects has now been worked down, most of the subjects recommended to the Master Mechanics' Association would be more suitable for the Traveling Engineers, the General Shop Foremen and other associations whose members are under the supervision of the motive power heads. We have no doubt that by a process of natural selection the investigation of the different subjects will reach the hands of those best able to throw light upon them.

Electric Passenger Traffic.

INTERBOROUGH RAPID TRANSIT — SUBWAY-NEW YORK CITY.

Cars owned	1,144
Passengers per year	327,471,000
Passengers per car per year	286,250

MANHATTAN ELEVATED LINES—NEW YORK CITY.

Cars owned	1,781
Passengers per year	306,845,000
Passengers per car per year	172,280

BROOKLYN RAPID TRANSIT—BROOKLYN-NEW YORK CITY.

Cars owned	945
Passengers per year	162,514,055
Passengers per car per year	171,900

CHICAGO ELEVATED ROADS—CHICAGO.

Cars owned	1,420
Passengers per year	164,164,000
Passengers per car per year	115,530

Improved Railway Street Crossing

The street crossing and its difficulties has been a matter of much concern, both to the public and railway men, especially in the North. Due to danger, inconvenience, and expense of street crossings, grading and elevation wherever practicable have in a measure done away with the same. However, somewhat remains to be done, to secure the highest interest of all concerned. This problem appears to be solved in a new and useful improvement known as the "Metallic Hollow Street Crossing System," invented by F. A. Brewer, of East Syracuse, N. Y. The object of which is to take the place of wooden planking next to the rails, on railway street crossings.

The new method has met with the approval of railway engineers and officials, as far as it has been properly introduced.

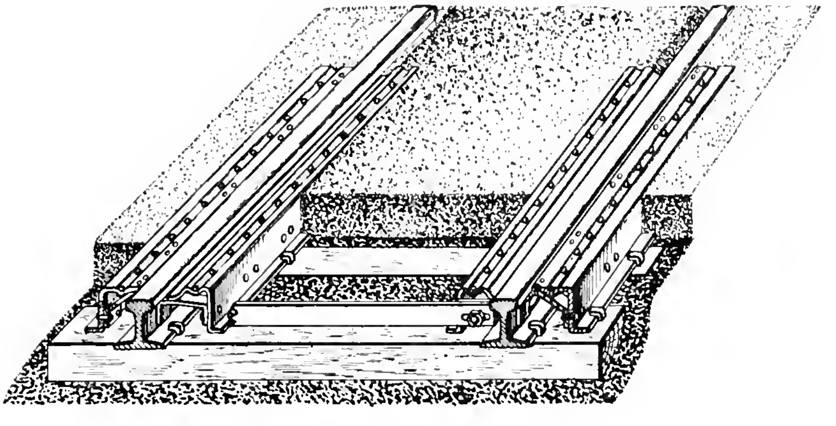
The metallic system is champhered or grooved on the inner side of the rail, for the travel of car wheel flanges and the grooves also more or less answer the purpose of guard rails, and may serve materially in preventing the car wheels from leaving the rails. Again the grooves are so constructed as to allow little chance for ice formation.

The metallic system is chamfered or vertical and horizontal flanges, running lengthwise with the rail; the vertical flange has a narrow web on which it rests, against which the ordinary spike may be used to hold the system in place. The horizontal flange is provided with a grooved or roughened surface to prevent horses from slipping. The outer edge of this flange is rounded to make an easy approach for auto and wagon tires. End plates or cross bars are provided to keep the gravel or filling flush with the system. A simple method of detachable lugs are provided to hold the system in place, these lugs are adjusted under the ball and on the flange of the rail, by which means also joints are enclosed without any cutting to be done, and it is immaterial where the joint comes, therefore the system may be moved or exchanged conveniently. In addition to this the patents cover a one-piece system for use outside of joints.

A number of roads to overcome a few minor difficulties are using steel rails. This is done by placing the ball against the neck of the main rail, thus forming a groove on the upper side for the travel of car wheel flanges.

The minimum cost of production is not necessarily the principal point of interest in every case. The businessman's attention is, first of all, drawn toward points of merit. First, the hollow system is very simple to make, and it answers every desired purpose. Nearly the entire system may be rolled out of sheet metal by the use of a channeling machine.

For simplicity, safety, durability, convenience, neatness of appearance, reasonable cost of production and final economy the hollow system is a decided improvement.



AN IMPROVEMENT IN RAILWAY STREET CROSSING.

A Grain of Wheat.

There are many curious features about ordinary things which make edifying reading for people inclined to acquire useful information. For instance, if you pluck a wheat plant about harvest time, you will find that it consists of a stem or straw which ends in a root at one end and a root at the other, and that blades or leaves are attached to the sides of the stem. The ear contains a multitude of oval grains which are the seeds of the wheat plant. When these seeds are cleared from the husk or bran in which they are enveloped, they are ground into fine powder in mills and that powder is the flower from which bread is made. If a handful of flour mixed with a little cold water is tied up in a coarse cloth bag and this bag is then put into a large vessel of water and well kneaded with the hands, it will become pasty, while the water will become white. If this water is poured into another vessel and the kneading process continued with some fresh water, the same thing will happen. But if the operation is repeated, the paste will become more and more sticky, while the water will be rendered less and less white, and at last will remain colorless. The sticky substance, which is thus obtained by itself, is called gluten; in commerce it is the substance known as macaroni.

If the water in which the flour has been washed is allowed to stand for a few hours, a white sediment will be found at the bottom of the vessel, while the fluid above will be clear and may be poured off. This white sediment consists of minute grains of starch, each of which, examined with the microscope, will be found to have a concentrically laminated structure. If the fluid from which the starch was deposited is now boiled, it will become turbid, just as white of egg diluted with water does when it is boiled, and eventually a whitish, lumpy substance will collect at the bottom of the vessel. This substance is called vegetable albumin.

Besides the albumin, the gluten and the starch, other substances about which this rough method of analysis gives no information, are contained in the wheat grain. For example, there is woody matter or cellulose, and a certain quantity of sugar and fat. It would be possible to obtain a substance similar to albumen, starch, saccharine and fatty matters, and cellulose by treating the stem, leaves and root in a similar manner, but the cellulose would be in far larger proportion. Straw, in fact, which consists of the dry stem and leaves of the wheat plant, is almost entirely made of cellulose. Besides this, however, it contains a certain proportion of mineral bodies, among them pure flint or silica. In the living plant, all these bodies are combined with a large proportion of water, or are dissolved or suspended in the fluid. The relative quantity of water is much greater in the stem and leaves than in the seed.

Odious Comparisons.

It is not often now-a-days for railroad officials to be able to answer a question by quoting an apt text of Scripture, but there have been such men. John P. Laird, a worthy Scot, was at one time superintendent of motive power of the Pennsylvania Railroad and left his betterment mark thereon. A new general superintendent came to the road and asked John what kind of people there were in the service. The answer was: they are described in II Corinthians ch:12. It reads: "For we dare not make ourselves of the number, or compare ourselves with some that commend themselves, but they measuring themselves by themselves, and comparing themselves among themselves are not wise." Of course that was the Pennsylvania Railroad of ancient times.

The Hancock Coal Sprinkler

Most accidents in a locomotive cab are due to the failure of the coal sprinkling apparatus. Water for sprinkling is usually taken from the delivery pipe of the injector, and the temperature is so high and the pressure so great that when the delivery hose become clogged, as it frequently does as a result of the heat and pressure destroying the inner lining, the hose either bursts or is blown off the connection, scalding the occupants of the cab. Of all cab accidents 70 per cent. are said to come from this source.

The Hancock Sprinkler, which acts on the principle of an ejector, is so designed that it is absolutely proof against accidents of this kind.

The principal feature of the Hancock Coal Sprinkler (made by the Hancock Inspirator Co., New York) is a valve which automatically discriminates between steam and water and its action is so positive and reliable that there cannot be a sudden and unexpected discharge of steam through the hose.

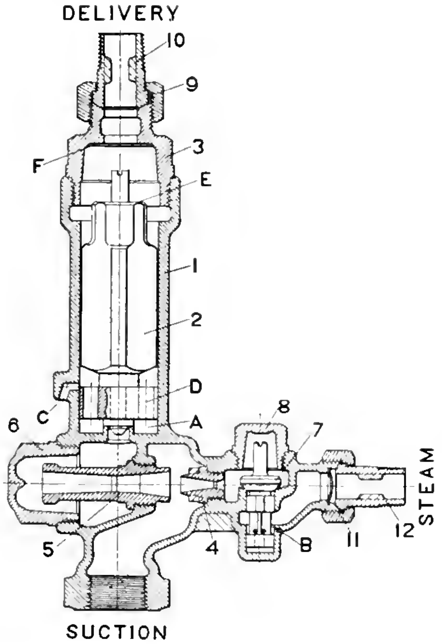
The sprinkler is generally applied on the strainer or on the suction valve of the injector of the locomotive by the use of a short connecting nipple having a bend so that the sprinkler will be in a vertical position. A valve is placed in the steam pipe at a point where it can be conveniently reached.

In operating the coal sprinkler the steam valve in the pipe is opened wide and that action opens the valve 7. That action also closes the drip hole B, the piston end on the lower end of guiding stem covering the hole. Steam will now flow through nozzle No. 4 forming a jet and combining with water in valve 5. (But there never will be a flow of steam in starting because tubes 4 and 5 are always under water by reason of the location of the sprinkler at a point lower than the tank.)

Steam will flow into the pressure chamber A and valve 2 which has been closed heretofore will be lifted. Port C which has been opened heretofore will also be closed and the water will be forced through the delivery pipe and into the delivery hose.

The accidents resulting from the use of a sprinkler have generally been caused by an interruption of the water supply due to an obstruction such as leaves waste or coal at the strainer, or by the failure of the injector to work. Should the flow of water be interrupted or the injector refuse to work, where a Hancock coal sprinkler is used the valve No. 2 which discriminates between steam and water will close the sprinkler so that no steam will escape into the hose; instead the steam will be blown back toward the suction pipe, will flow into the pressure chamber A, and force valve 2 upward. The end E of valve 2 will seat against the surface F, thus making it impossible for steam to flow into the delivery tube.

When not operating, both valves will seat. The discriminating valve No. 2 is heavy enough to prevent water flowing up the delivery pipe and then all the water in the delivery pipe will flow out of the drain hole C. At the same time steam valve 7 will seat, no water will flow up the steam pipe and all water or steam in the steam pipe will drain out at the hole B.



SECTION VIEW OF HANCOCK COAL SPRINKLER.

This sprinkler uses comparatively cold water, no steam can escape, it is self draining and can not freeze.

Good Fuel Supply.

When scientific men congregate for the purpose of alarming people with dreadful predictions which their learning has demonstrated to be true, one of their most alarming items of information is concerning the comparatively short time in which the world will enjoy the warmth of a bright coal fire. Calculations sent forth are to the effect that we are using up the world's coal supply so rapidly that within a few short years the supply of black diamonds will be all burned up.

On recently reading a statement in a bulletin published by the United States Bureau of Mines concerning the supplies of coal and lignite in the United States our alarm was much modified. The report shows that we have still an easily accessible supply amounting to 2,004,018,000,000 tons.

After this is all burned up we will not likely be here to worry about it, and it may be relied on that something equally as good will be found.

RAILROAD NOTES.

The Texas and Pacific is in the market for 20 locomotives.

The Western Maryland is reported in the market for 20 consolidation locomotives.

The Missouri Pacific has ordered 83 passenger coaches from the American Car & Foundry Co.

The Buffalo Creek has ordered three locomotives from the American Locomotive Co.

The Bangor & Aroostook has ordered 117 box cars from the Standard Steel Car Company.

The Cuba Railroad has ordered eight locomotives from the American Locomotive Company.

The Atlantic Coast Line has ordered 15 passenger cars from the American Car & Foundry Co.

The Nevada Northern has ordered two consolidation locomotives from the American Locomotive Co.

The Philadelphia & Reading has ordered 1,000 steel hopper cars from the Cambria Steel Company.

The Atlantic Coast Line has ordered 25 Pacific type locomotives from the Baldwin Locomotive Works.

The Missouri & North Arkansas has purchased four locomotives from the Baldwin Locomotive Works.

The Missouri & North Arkansas has ordered four freight engines from the Baldwin Locomotive Works.

The Chicago & Illinois Midland has ordered two Mikado locomotives from the American Locomotive Company.

The Chesapeake & Ohio has ordered 6 Pacific type and 6 Mikados from the American Locomotive Company.

The Buffalo, Rochester & Pittsburgh has ordered 10 Mikado locomotives from the American Locomotive Company.

The Southern has bought 2,000 cars, 1,600 from the American Foundry and 400 from the Vernon Car Company.

The Delaware, Lackawanna & Western has placed an order for 14 locomotives with the Lima Locomotive Corporation.

The Pennsylvania Southern has ordered 100 steel hopper gondolas, which

are now being built by the Standard Steel Car Co.

The Buffalo, Rochester & Pittsburgh has ordered two Pacific and five Mallet type locomotives from the American Locomotive Co.

The New York Central is in the market for 500 steel automobile cars, 1,000 steel underframe box cars and 1,100 coal cars.

The Great Lakes Stone & Lime Co., of Alpena, Mich., has ordered four switching locomotives from the Baldwin Locomotive Works.

The Chesapeake & Ohio has ordered six Mikado locomotives, six Pacific locomotives and two consolidations from the American Locomotive Co.

The Esquimalt & Nanaimo will construct terminal facilities, including a round house, passenger and freight stations, etc., at Courtenay, B. C.

Extensive improvements in the way of additional shops, yards and larger terminal facilities on the Southern, it is said, are to be begun at once.

Illinois Central orders for steel rails have been increased to 67,000 tons. Over one-half the amount will be made at the Illinois Steel plant.

Morris & Co. Refrigerator Line, Chicago, Ill., has 200 steel underframe refrigerator cars now under construction by the Haskell & Barker Car Co.

The Atchison, Topeka & Santa Fe will probably commence work in the spring on the double tracking of the main line from Newton to La Junta, Colo.

The Waverly Oil Works has ten 12,600 gallons capacity tank cars, one 6,000 gallon tank car and thirty-five 6,500 gallon tank cars for sale or rent.

President Wilson, on March 12, signed the bill authorizing the expenditure of $35,000,000 for the construction of a government owned railroad in Alaska.

The Illinois Central has ordered 73 locomotives; 23 switchers from the American Locomotive Company and 50 Mikados from the Baldwin Locomotive Company.

The Moshannon Coal Mining Company has 100 wood hopper 60,000-pounds capacity cars, 25 steel hopper 100,000-pounds capacity and 10 wood hopper 80,000-pounds capacity for sale.

The St. Louis & San Francisco has approved plans for the proposed new freight depot at Tulsa, Okla., the main building of which will be 40 x 330 feet, with an extension open platform 40 x 200 feet.

The Chicago & Alton now has a continuous telephone dispatching system between Chicago and St. Louis, a distance of 280 miles. The telephone system of dispatching will be extended at an early date.

The track revision work that the Chicago, Milwaukee & St. Paul railroad is doing in connection with double tracking its line through Iowa, will be resumed in the county probably in April.

The New York Central & Hudson River is in the market for 500 steel automobile cars, 1,000 steel underframe box cars, 1,000 50-ton hopper cars, 1,150 hopper bottom gondola cars, and 500 automobile cars.

The Missouri Pacific has placed an order for 83 all-steel passenger cars with the American Car & Foundry Co. The cost of this new equipment, approximately $1,000,000, will be financed by the sale of equipment trusts.

The Atchison, Topeka & Santa Fe will spend $1,000,000 for improvements at Richmond, Cal., it is said. Additional shop buildings will be erected, extensions made to present piers and wharves and the freight yards will be extended.

The Calgary branch of the Canadian Northern has been extended from Munson, Alta., to Calgary. This road will construct a line in Alberta this year, from Bruderheim to Wainwright, thence to Medicine Hat and the international boundary.

The Cambria Steel Company is to roll 3,000 tons of open-hearth rails for the Great Northern, which tonnage is a part of the contract for 15,000 tons, including 3,000 tons to be rolled by the Pennsylvania Steel Co. and 9,000 tons by the Illinois Steel Co.

At Montgomery, Ala., a fire destroyed the car shops of the Western of Alabama Ry. in this city, entailing an estimated loss of $30,000. Snow on the wires is claimed to have short-circuited an electric line, causing the fire, aided by an explosion of a small gas tank.

The Safety First Manufacturing Co. has been organized with offices in the Railway Exchange building, Chicago. It will handle various high-class railway specialties, besides taking over the business of the E. D. E. Company, of which the late Mr. Frank M. Gilmore was president.

Books, Bulletins, Catalogues, Etc.

Locomotive Headlights.

A government report giving in full the hearings before a sub-committee of the Committee on Interstate and Foreign Commerce of the House of Representatives on bills relating to safety on railroads is just made public and extends to nearly 200 pages. It is entirely devoted to the subject of Headlights on Engines. The meetings of the sub-committee extended from January 16 to January 24, of the present year, and the report is particularly interesting from the fact that much light is thrown upon the darkened condition of the various Legislatures that have passed laws calling for headlights capable of 1,500 candle power, when up to the present time no light of such power, excepting in momentary flashes at certain angles, has yet been placed on a locomotive. This important question so full of consequence to railroads should have been before a properly qualified commission or committee before, and while the end is not yet, an important step has been made in the right direction. The evidence furnished by Mr. D. F. Crawford, general superintendent of motive power of the Pennsylvania lines west of Pittsburgh, was particularly interesting, embodying as it did the work of several years of American Railway Master Mechanics' Association, a special committee of which, under the chairmanship of Mr. Crawford, had taken up the subject of determining, if possible, the maximum and minimum illuminating power of headlights that they could approve for use on locomotives. The committee had made investigations and tests of 30 different headlights in about 200 combinations. Their completed report is not yet made public, but from Mr. Crawford's evidence it was readily discernible that the laws that have been passed in a number of States are based on a pitiable lack of knowledge on so important a subject.

Mr. Crawford's evidence was sustained by other members of the Master Mechanics' Committee, and the publication of their completed report will be awaited with much interest. The evidence given by Mr. Oscar F. Ostby, of the Commercial Acetylene Railway Light & Signal Company, was also very illuminating. In his interesting statements it appeared that the acetylene light which is now in service on thousands of locomotives, the light proper is rated at 37 candle power, and by the use of a reflector is raised to 14,000 candle power, but he made no claims that it had yet reached the 15,000 mark set by several Legislatures. Acetylene was claimed to be free from fluctuations, and also from the peculiarity of electricity in changing the colors as claimed to have been observed by many engineers of vast and varied experience.

The subject is full of interest, and, as we stated, the Master Mechanics' Committee's report will be expected to throw much fuller light on the subject as the hearings before the Committee of Congress was much too short and some of the members of the committee were evidently much in the dark on so important a subject to be able to make particular recommendations. As it is the document is a valuable contribution to the railroad literature of our time.

Engineer's Reference Book.

The popularity of this excellent work is evidenced by the publication of a fourth edition from the publishing house of Charles Griffin & Co., London, and J. B. Lippincott Company, Philadelphia. The author, H. H. Suplee, B. Sc., M. E., is an eminent writer on engineering subjects, and his popular reference book differs in some degree from the ordinary engineering hand book. It is practically a book of tables, formulas and methods for engineers, students and draughtsmen. It is intended to be the successor of Nystrom's Mechanics, which was, in its day, a most useful and handy compendium of information on all subjects connected with engineering. Suplee's work is of convenient size, and is divided into fifteen sections, and thumb-nailed so as to be easily opened at the desired section without special reference to the index.

There is also an admirable brevity and directness in the work. The results are easily obtained without wading through intricate problems. Every department of applied science is dealt with, and compressed into small space. The book has also the advantage of being in the very forefront of modern engineering. This is particularly noticeable in the electrical department, where there is superadded a great number of notes, not only useful in various inquiries, but there are many neat little explanations of the equivalents and expressions of electric and mechanical data, and analogies between the flow of water and electricity.

The last section is devoted to cost of power. This gives data concerning water plants, costs of water power, steam power as shown by a series of tests made with fuel burned directly under the boiler and the use of producer gas power and cost of electric power. An appendix of forty pages is added in the new edition. It contains a variety of useful information on all kinds of engineering topics. Altogether the book is most fully what it purports to be—a ready, useful and comprehensive collection of all kinds of data required and most likely to be used by a mechanical engineer in the practice of his profession. Price $5.

Industrial Training.

The Canadian Royal Commission on Industrial Training and Technical Education has just issued its annual report, and the bulky volumes have much more interest to the general reader interested in economic questions than official reports usually have. The commendable work of the commission in providing sound technical instructions for young men and women engaged in various trades and industries is being carried with a degree of thoroughness that is very creditable to the Dominion Government. It is especially noteworthy that this form of national instruction is designed, not to supersede, but to supplement the training of the workshop or other place of business. The secondary object is to promote general knowledge by means of classes in arts and crafts, higher commercial subjects, languages, domestic economy, music, etc. The system also does much to facilitate social intercourse among its students. Healthy recreation and amusement is afforded by its various clubs and societies.

Much space is devoted to comparisons with the work in other countries, particularly in Great Britain as well as the United States, and it must be stated that the reports of the work in Canada is in the very front of the educational work of our time.

National Malleable Castings.

Three new circulars have been issued by the National Malleable Castings Company, Cleveland, Ohio. They are numbered respectively: 51, 65 and 66. No. 51 deals with rail braces and tie plates, and as is well known there is no other place in railroad service where the prevention of rust is so difficult, and in the continued experiments that have been made, the superiority of malleable iron over steel have been clearly demonstrated. Varieties of designs of rail braces and tie plates that have stood the test of years are shown, and other designs can be furnished to suit any type or weight of rail.

No. 65 refers to the national safety brake lever. There are over one hundred different sizes of this improved lever made also of malleable iron. The lever is furnished with two safety lugs, one cast on each side just above the fulcrum pin hole, which strike against the edges of the fulcrum in case the fulcrum pin comes out and prevents the lever from slipping through it. It never failed.

No. 66 illustrates and describes the national safety clevis and pin for uncoupling rods. The loss of the cotter in the clevis pin had become a serious matter in modern railway traffic, until the introduction of this clever device whereby the pin is permanently fastened in one eye of the clevis and cannot possibly be lost. The pin is locked in place without depending on a cotter to hold it. It conforms to the M. C. B. standards. Send for copies of the circulars to the company's office at Cleveland.

Locomotive Hoists.

The Whiting Foundry Equipment Company has issued a Locomotive Hoist Catalogue, No. 105, and describes the special advantages of their very efficient and economical machine for wheeling locomotives. Reproductions of photographs of actual installations show the different steps in operating the hoist. It is a great time and labor saver in repair shops of moderate capacity, particularly at division points, where the larger kinds of heavy traveling cranes are not in service. In fact, the installation of these hoists displaces the expensive traveling crane, and the entire cost of structural work in connection with the traveling cranes. The mechanism consists principally of two stationary and two movable screw jacks, located in pairs on opposite sides of railroad track. The screw jacks rest squarely on the rails. There can be no rocking or vibrating as the support is rigid. Lifting beams extend from the one jack to the other at right angles. An electric motor drives the shafts which operate the hoisting mechanism through bevel and worm gearing. The placing of the jacks and hoisting can be accomplished in half an hour. Send for a copy of the catalogue to the company's office at Harvey, Ill., and learn the complete details.

Weed Burners and Snow Melters.

The Lamb Weed Burner has grown in popular favor and has done effective work in destroying the undesirable vegetation that is apt to rush up on railroads in certain parts of the country. The passing season has also demonstrated the fact that it is available for use in freeing frogs, switches and interlocking devices from snow and ice. By its application a switch can be entirely freed in a few minutes. It consists of a battery of burners mounted on a carriage so that the battery can be projected out over the end of the car. The battery is extended ten feet from the car. It is controlled by cylinders actuated by compressed air from the locomotive. The battery can be raised or lowered. There are seven burners, 16 inches inside diameter pierced with holes. The fuel is gasoline introduced into coils inside the burners, which are cast iron shells, and from which gas is generated. The fittings are of the most durable kind, and the fire is under complete control at all times. The apparatus, as now perfected, is the result of many years of investigation and experience by Mr. W. W. Lamb. For illustrated catalogue and full details, apply to The Lamb Railway Service Company, Cincinnati, Ohio.

Cincinnati Milling Machines.

The Cincinnati Milling Machine Company, Cincinnati, Ohio, have issued a handsome catalogue of 128 pages, profusely illustrated, with descriptive matter giving full details in regard to their latest improvements in milling machines, plain, universal and vertical; high power with constant speed drive, cone driven; milling machine attachments; also semi-automatic manufacturing millers and universal cutter and reamer grinders. These machines are designed to meet the most exact requirements. They embody certain desirable exclusive features in design. The materials are of the best. A degree of perfection has been arrived at that is the result of specialization. As a proof of the popular favor that has come to the enterprising company they have now the largest plant in operation in the world devoted exclusively to the manufacture of milling machines and milling cutting grinders. All interested should apply for a copy of the new catalogue from the company's office at Cincinnati, Ohio.

Crabs and Winches.

Pamphlet C, 1914, just issued by the Brown Hoisting Machinery Company, Cleveland, Ohio, presents in an elegant bulletin descriptive matter and illustrations of their fine products. These include their standard Crab in four sizes, and Winches in four sizes. These have had the test of experience and have been improved upon until a degree of perfection has been arrived in design and construction that could not be surpassed. A safety-lowering device has been recently introduced and has already met with much favor.

This is only one of the catalogues and bulletins, of which there are no less than fifteen issued by the enterprising company, descriptive of their numerous mechanical appliances, and copies of any or all of them may be had on application at the company's main office, Cleveland, Ohio.

The Railway Library.

This is a collection of noteworthy addresses and papers on railroad topics compiled by Mr. Slasen Thompson and published by Stromberg, Allen & Co., Chicago. Most of them have been delivered last year. The themes presented range from a description of the "Safety First" movement to summaries of the railroad situation in various foreign countries. The papers and addresses are all by well-known authorities and the book is indispensable for anyone interested in railroad management or investment in railroad properties. The book is sold at fifty cents per copy.

Weir Feed Water Heaters.

The Weir system of feed pumps and feed heaters for locomotives, and to which reference was made in our last issue, has branch offices established at 52 Broadway, New York. The main offices are at Cathcart, Glasgow, Scotland, with branches in London, Newcastle-on-Tyne, and at Liverpool. Mr. James Lamont is manager of the New York branch. The company's illustrated descriptive catalogue may be had on application to the New York branch.

WIT AND WISDOM.

Obeying Orders.

An obstreperous Irishman, employed in the machine shops of the Baldwin Locomotive Works, had made so much trouble there that the superintendent decided to get rid of him. Knowing that a verbal dismissal would make trouble and cause a scene, the superintendent decided to write Pat, which he did, telling him his services were no longer required. Accordingly Pat apparently dropped out. About a week later, however, as the superintendent was passing through the shop one day, to his utter surprise he saw Pat at his lathe. He stopped and said: "Pat, what the dickens are you doing here?" Pat replied: "Shure, I am wurkin, sor." "Well," said the superintendent, "that's funny. Didn't you get a letter from me?" "Shure, Oi did, sor." "Did you read it?" "I did, sor, on the inside and on the outside, sor." "Well, what did it say?" "Shure, sor, on the inside it said 'Pat, you're fired,' and on the outside it said 'Afther foive days return to the Baldwin Locomotive Works.'"

Memories of the Zoo.

"What is the fare to Pretoria, please?"

"Five shillings—I've told you that eight times now."

"I know you have, but little Willie here likes to see you come to the window. He says it reminds him of the Zoo."

Dr. Johnson once said to Boswell that a woman speaking in public always reminded him of a dog walking on two legs. The wonder with him was, not that the dog did it well, but that he did it at all.

One feast, of holy days the crest,
 I, though no churchman, love to keep,
All-Saints—the unknown good that rest
 In God's still memory folded deep;
The bravely dumb that did their deed,
 And scorned to blot it with a name,
Men of the plain heroic breed,
 That loved Heaven's silence more than fame.

—JAMES RUSSELL LOWELL.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

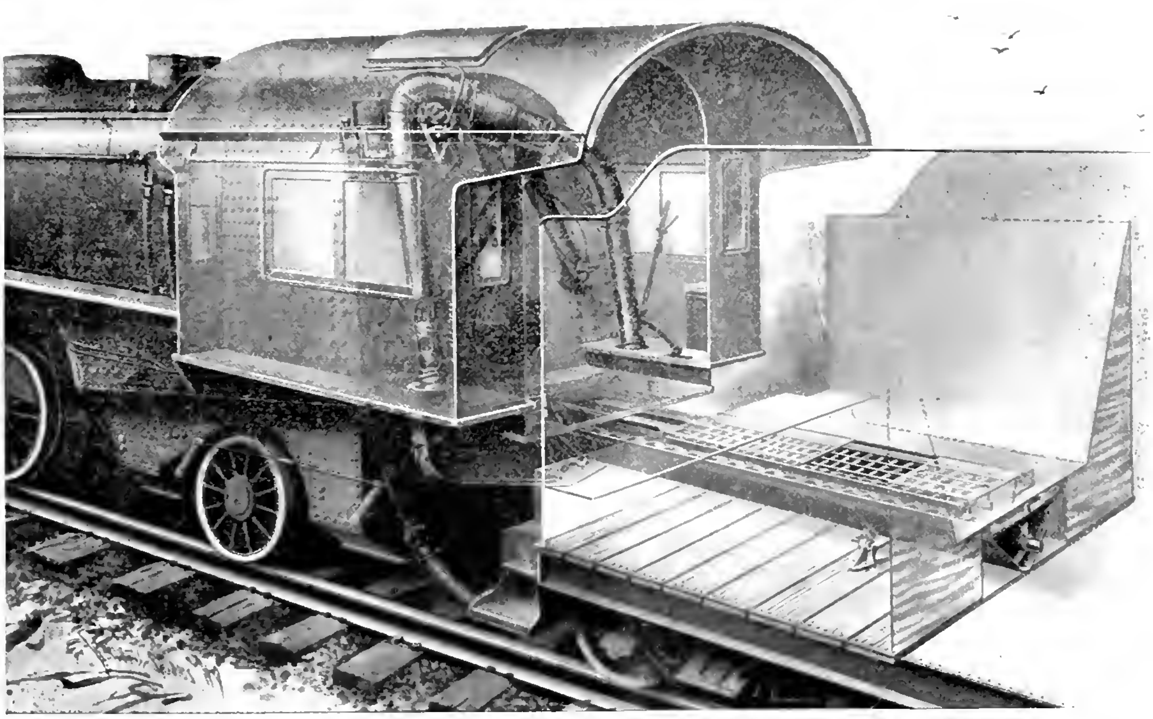
Vol. XXVII. 114 Liberty Street, New York, May, 1914. No. 5

The Street Locomotive Stoker

The growing necessity for a locomotive stoker has drawn the attention of a number of eminent engineers and inventors for several years to furnish appliances to meet the requirements of locomotive service. It might seem at first glance that if mechanical stokers have proved eminently successful on stationary boilers they might readily be adapted to overcome any advantage that a mechanical stoker possessed.

Some of the early experimenters fell into the error of combining a coal crusher and stoker. It has been clearly demonstrated that the tender of a locomotive is no place for a coal cracker. The coal must undergo some elemental preparation in order to be adapted for ready use in the details of the preceding appliances.

The machine in its new form consists of a screw conveyor for moving prepared coal from the tender to the locomotive an elevator for raising the coal to a point above the fire-door, a regulating system for delivering the coal to the fire-box, and an adjustable distributing system for spreading the coal over the grate. On



THE STREET LOCOMOTIVE STOKER IN POSITION ON THE LOCOMOTIVE AND TENDER.

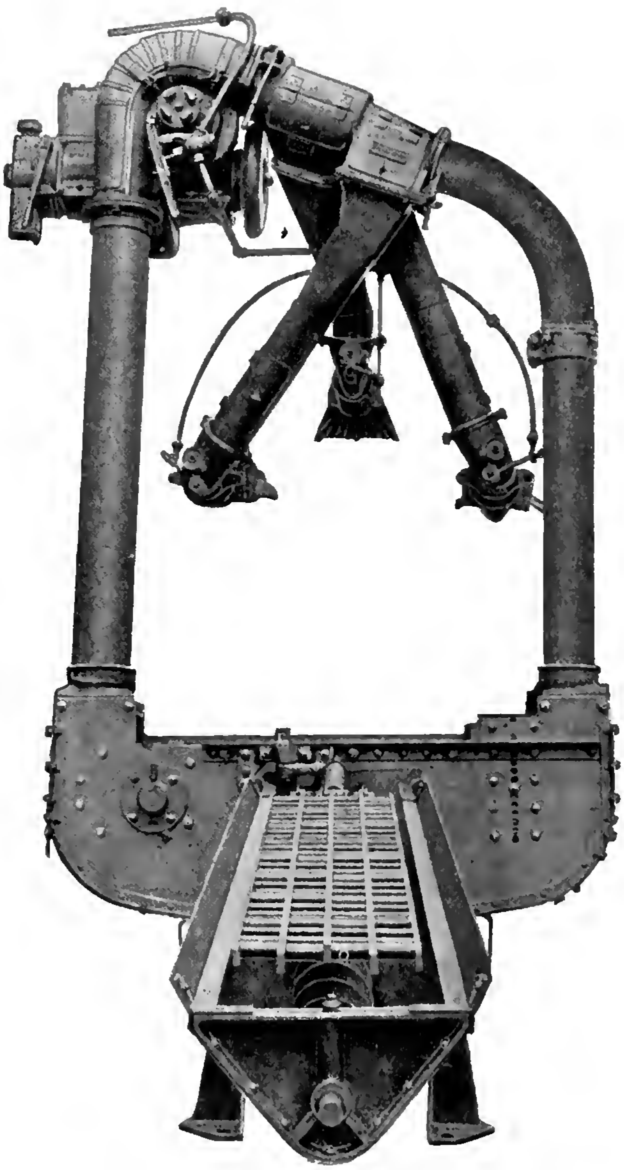
locomotive service The problem, however, is a difficult one. The space is limited, the service must have the element of flexibility as the requirements are variable. The elements of simplicity and reliability must be assured, and the mechanism must also be easy of operation as the use of two much steam in propelling the mechanism might readily a mechanical stoker. This idea has been wisely accepted by the Locomotive Stoker Company in the production of their latest improved stoker known as Type C, as it is the third and decidedly the best type of stoker that the enterprising company has produced. It is the result of seven years constant experimental work, and contains all that has been proved of real merit in the type B machine the small engine driving the appliance had a constant speed when in operation of 450 revolutions per minute. The improved machine can be run at varying velocities from 400 to 600 revolutions per minute, embracing seven different rates of speed. An important improvement has also been made on the connection between the engine and the

elevator by the introduction of a friction clutch which furnishes means for stopping the elevator at any moment, and allowing the engine to run—the buckets remaining filled with coal ready to begin feeding when the clutch is thrown in. This improvement, together with the speed changing device gives the fireman absolute control of the time and quantity of coal supplied to the fire.

Our frontispiece shows an excellent view of the stoker in position on a modern high-powered locomotive. A portion of the tank and cab of the engine is drawn in transparent or phantom style in order that the exact position of the parts may be clearly seen and a description of the parts readily understood. It will be noted that on the lower left side of the cab a part of the supply pipe casing is removed showing the buckets that carry the supply of coal to the distributors.

The second illustration is a front view of the new type of stoker. It will be observed that the elevator, regulating system, and screw conveyor are connected directly to the engine, so that any change in the various speeds of which it is capable results in a corresponding change in the speed of the entire machine. The maximum speed will supply six tons per hour, while the other six graduated, lower speeds will readily cover the coal requirements for any range of locomotive service that is liable to be demanded in modern locomotive practice.

The control levers are within ready reach of the fireman. The elevator, the buckets of which are shown in the illustration, consists of an endless chain of malleable iron buckets with pin connections, and is enclosed throughout its entire length. The uptake pipe is seven inches in diameter, and the return pipe six inches. The upper end of the elevator is firmly secured to the boiler head by a cast iron bracket, and the return bend is secured by a heavy forging.



FRONT VIEW OF STREET LOCOMOTIVE STOKER TYPE-C.

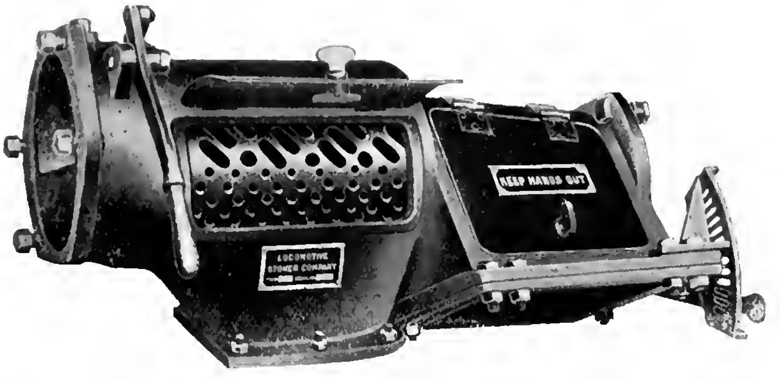
The screw conveyor which is located below the coal space of the tank and carried in a strong sheet steel trough, rests in a slide support bolted to the floor of the tender frame. The conveyor consists of a helicoid steel screw. A flexible connection takes care of all movements between the locomotive and the tank. As will be observed in the first illustration there is a bar screen in the floor of the tank immediately above the screw-conveyor. This screen has meshes about two and a half inches square All coal must pass through this screen in order to reach the screw. The screen is carried in slide supports and has a reciprocating motion of about six inches, and this motion facilitates the passage of the coal through the openings. There is also a series of cover plates above the screen also resting in slide supports, for use in regulating the supply of coal, or stopping the supply altogether, if desired. A malleable iron link belt chain moving over two sprocket wheels gives motion to the screw. Those sprocket wheels may be varied and changes may be advantageously made so that the speed of the screw may be altered in relation to the speed of the elevator to suit the requirements of the service.

The elevator engine is of the single-acting type, having a cylinder 4 inches by 3½ inches, with a governor and also an auxiliary spring, which gives the speed variations to which we have already referred. All of the lubrication is done from the splash of the crank-case, except the valve and piston, to which oil is supplied from the main lubricator by an extra tap provided for that purpose.

Coming to the discharge pipe, it will be noted that it is located in the central upper portion of the elevator casing, and embodies mechanism for dividing the coal between three distributors. The left-hand end carries a circular screen, made of sheet metal and furnished with four sets of perforations of different sizes. Our third illustration shows the discharge pipe with door open showing the screen. The coal, after entering the discharge pipe, is dragged by the elevator over this screen, and the smaller particles of coal pass through it into the center distributor. Any particles too large to go through the screen pass over it, and are divided between the right and left-hand distributors. The quantity of coal going into the center distributor is varied by changing the size of the openings brought into use on the screen. If a large amount of coal is wanted at a certain point, a larger set of holes is brought down to suit that point. A lever, hand operated, is provided as a means by which the fireman can bring the desired set of holes into use. A door is provided in the discharge pipe directly over the screen to give means for observing the position of the holes. The even distribution, and perfect leveling of the fire is thus readily and easily in the hands of the fireman.

The distributor pipes are located equally

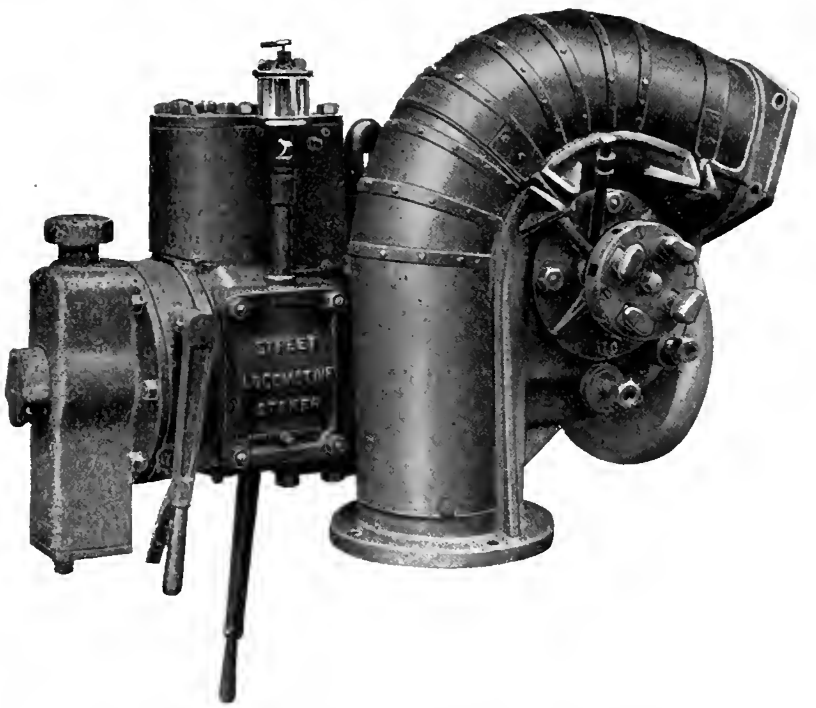
on the boiler head and held in place by studs. One is located directly in the center of the firebox and above the fire door, and each of the other two is on one side about midway between the center and the side sheets. Each elbow has a steam nozzle and through which steam is admitted for blowing the coal into the firebox. The elbows are also provided with peep holes two inches in diameter, with having eight projections of different sizes. These projections open the controller valve the desired amount and a series of handles are adapted for the fireman's use in making the changes of pressure desired. In regard to these valve handles and levers and other appliances, at first glance they seem somewhat complex, but in reality they are as simple and as easy to understand as are the gauge cocks,



THE DISCHARGE PIPE WITH DOOR OPEN SHOWING THE SCREEN.

swinging covers, through which the flow of coal can be readily seen. The center distributor, as we have stated, receives fine coal, and places it across the back end of the grates. The side distributors are different in form and are designed to receive larger particles of coal and spread them over that part of the grate blower valve or other boiler mountings.

Such are the chief features of the Street locomotive stoker, and as there are now over four hundred locomotives equipped with the appliance and a growing demand for more, it is unquestioned that the device is meeting the expectations of all who have given the matter any



FRONT VIEW OF ELEVATOR ENGINE AND SPROCKET WHEEL CASING SHOWING SPEED CHANGING LEVER AND FRICTION CLUTCH LEVER.

not covered by the center distributor. The distributors are now being made with a fireproof cement covering which lasts several months

There is also a clever device for controlling the steam jets which affect the distance that the coal is thrown into the firebox. This is a cam motion mounted on the end of the sprocket wheel shaft attention. Apart from the labor saving which is of growing importance, as the limit of human endurance in shovel firing has surely been reached, the appliance has established the fact that a much lower grade of coal can be used. This is an important item in many sections of the country. The increased quantity of poor coal necessary is a hard burden to an overworked fireman, but to a Street locomotive stoker, it is of no material consequence.

Speed Recorders.

Speed recorders have never been popular with locomotive engineers in America, but their use is making some progress for engines pulling fast trains. The Baltimore & Ohio has equipped most of its fast train locomotives with speed recorders and it seems very proper that Mr. Frederick Kerby, master mechanic of that road at South Cumberland, Md., should have been appointed chairman of a Committee of the Traveling Engineers Association, to investigate "Advantages Derived from the Use of Speed Recorders and the Influence of Same on Operating Expenses." A circular has been sent out by Mr. Kerby which calls for sufficient information to form an exhaustive report, if the members respond as they ought to do. We trust that the members having any experience with speed recorders will let the association have all the information available.

Depreciation of Equipment.

The Pennsylvania Railroad Company charges depreciation and renewals of equipment of the following bases: Locomotives and passenger cars on a basis of 4 per cent of the original cost of the equipment, and on freight cars on a basis of 3 per cent. On such cost, for the reason that a locomotive will last about 20 years, and based on the final value of the scrap being 20 per cent. of the original value, the depreciation, plus the salvage, will equal the original cost. Wooden passenger cars will also last 20 years. As for steel cars it is not definitely known how long they will last, but in order to provide for the replacing of wooden with steel cars in a reasonable time, and for the steel cars when they shall have to be retired, 4 per cent. is the general average of depreciation.

Railway Supplies.

The American consulate general at Shanghai, China, has forwarded specifications and blue prints calling for supplies and equipment for the Canton-Hankow Railway. These supplies include steel bridges, two 12-ton traveling steam cranes, four 6-ton steam cranes, locomotives, passenger cars, rails, fittings, etc.

South Manchuria Railway.

Through traffic arrangements have been completed between the South Manchuria Railway and the government railways in Japan and Chosen. The South Manchuria Railway has also made its freight tariff on most goods the same between Antung and interior Manchurian points, and Dairen and interior Manchurian points

Triplex Compound Locomotive for the Erie Railroad

Latest and Most Powerful Type in the World, Equipped with Street Stoker, Schmidt Superheater, and Gaines Furnace and Combustion Chamber.

The Baldwin Locomotive Works has recently completed, for the Erie Railroad, a locomotive for pusher service, which develops a tractive force of 160,000 pounds, and is by far the most powerful locomotive yet built. This capactiy is secured not by using excessive wheel-loads or a rigid wheelbase of unusual length, but by placing driving-wheels under the tender and thus making the weight of the latter available for adhesion. In heavy grade work especially the weight of the tender detracts materially from the net hauling capacity of a locomotive of the usual type; while in this case the tender is used as a means for increasing hauling capacity.

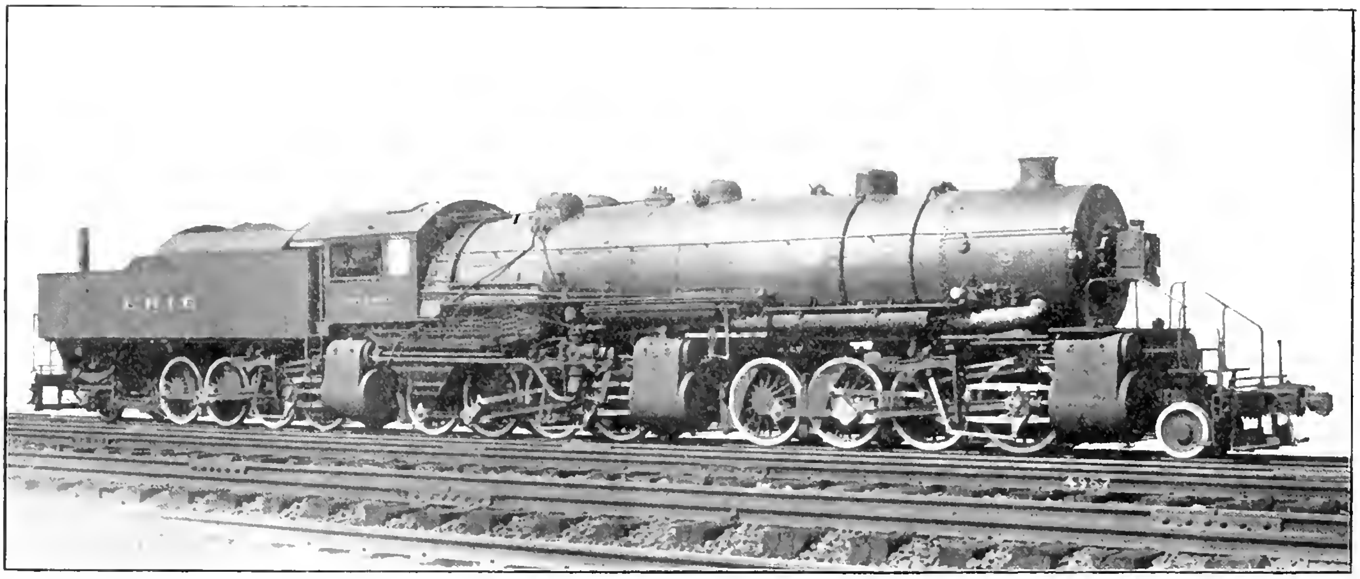
This locomotive is built in accordance with patents granted to George R. Henderson, consulting engineer of The Baldwin Locomotive Works. The wheel arrangement is 2-8-8-8-2, the third group of driving-wheels and the rear truck being placed under the tender section. The cylinders are all of the same size, two acting as high pressure and four as low pressure. The two high pressure cylinders drive the middle group of wheels. The right-hand high-pressure cylinder exhausts into the two front cylinders, and the left-hand high-pressure cylinder exhausts into the two rear cylinders. This arrangement is therefore equivalent to a compound engine having a ratio of cylinder volumes of one to two.

The boiler has a conical connection in the middle of the barrel, and is fitted with the Gaines type of furnace. The firebox has a total length of 13 ft. 6 ins., and of this the grates occupy 10 ft. A combustion chamber 54 ins. long extends forward into the boiler barrel, and the tubes have a length of 24 ft. The brick arch is supported on six 3½ in. tubes; and heated air is delivered under the arch by seven 3 in. pipes which are placed vertically in the bridge wall. There are two fire-doors, placed 32½ ins. between centers; and a Street mechanical stoker is applied.

The barrel of this boiler measures 94 ins. in diameter at the front end and 102⅛ ins. at the dome ring. The center line is placed 10 ft. 7 ins. above the rail. The circumferential seams are triple riveted, while the longitudinal seams have sextuple riveted butt joints, which are welded at the ends, and have an efficiency equal to 90 per cent. of the solid plate. The dome is of pressed steel, 33 ins. in diameter and 13 ins. high. It contains a Chambers' throttle, which is connected with the superheater header, in the usual manner, by an internal dry pipe. The superheater is composed of 53 elements, and is the largest ever applied to a locomotive; the superheating surface being 1,584 square feet. The header is divided, separate casings being used for saturated and superheated steam sections. The front end contains a single exhaust nozzle, with ring blower. The size of the nozzle can be varied by a simple adjusting device placed outside the smokebox. The stack is 22 ins. in diameter, and it has an internal section which extends down to the center line of the boiler.

The superheated steam is conveyed to the high-pressure cylinders through outside pipes, and the high-pressure distribution is controlled by 16-in. piston valves, arranged for inside admission. Similar valves are applied to the low pressure cylinders. These valves are all driven by Baker gear, and the three sets of motions are controlled simultaneously by the Ragonnet power reverse mechanism. All six cylinders are cast from the same pattern, and the valve motion and driving gear details used with the three groups of wheels are as far as possible interchangeable. A large number of these details also interchange with those of the heavy Mikado type locomotives in service on this road.

Among the details of the driving gear may be mentioned the pistons, all six of which are alike. The piston heads are steel forgings, of dished shape; and each is surrounded by a cast iron bull ring. The bull ring carries three packing rings, and is secured to the piston head by a retaining ring which is electrically welded



TRIPLEX COMPOUND, 2-8-8-8-2, TYPE LOCOMOTIVE FOR THE ERIE RAILROAD.

Wm. Schlafge, Gen. Mech. Supt. — Baldwin Locomotive Works, Builders.

into place. The cylinders and steam chests are bushed; and these bushings, as well as the piston and valve packing rings, are of Hunt-Spiller metal.

The pipes connecting the high and low-pressure cylinders, are constructed like the flexible pipes in a Mallet locomotive. The high pressure cylinder saddle has cored in it two passages, one of which conveys the exhaust from the right-hand cylinder to the front receiver pipe, while the other conveys the exhaust from the left hand cylinder to the back receiver pipe. The front cylinders exhaust up the stack in the usual manner, while the exhaust from the rear cylinders is discharged up a pipe placed at the back end of the tank. Between the rear cylinders and the exhaust pipe is placed a feed-water heater, through which the exhaust steam passes. The heater consists of a long drum, traversed by small tubes. The drum has connection with the tank through a suitable valve, and the exhaust steam passes through the tubes. The hot feed from the drum is forced into the boiler by two pumps, which are driven from the crossheads of the high pressure engine. Two injectors are also used, and they draw cold feed-water from the front end of the tank. The pump and injector checks are placed on the top center line of the boiler near the front end.

The tender section, as far as frames, wheels, equalization and driving gear are concerned, is arranged like a steam locomotive. The tank is supported on the frames by six bearers, which serve as transverse frame braces also. Three of these bearers are placed between adjacent pairs of driving-wheels; one is placed just back of the rear driving-wheels, one above the rear truck, and one under the back end of the tank. The width of the tank is 10 ft. 8 ins., and it is placed sufficiently high to clear the valve motion.

The articulated connection between the middle and rear frames is placed under the cab, and between the rear cylinders. The radius bar on the middle frames makes a ball-jointed connection with the hinge-pin. A similar connection is provided between the middle and front frames, and in this case the radius-bar is pinned to the front frames in such a way as to allow vertical flexibility.

The frames are vanadium steel castings, 6 ins. in width. Each is made in one piece with a single section to which the cylinders and saddle are keyed and bolted. The front group of wheels is arranged with a continuous equalization system, the leading truck being center bearing and equalized with the driving wheels as in a Consolidation engine. The second group of wheels has a continuous equalization system on each side of the locomotive. In the rear group, the equalization is broken between the second and third pairs of driving-wheels. The rear truck, which is of the side bearing type with outside journals, is equalized with the two rear pairs of driving-wheels.

The arrangement of starting valve usually applied by the builders to Mallet locomotives, is used on this engine; except that in the present case, live steam is admitted to four low pressure cylinders instead of two. The admission of steam is controlled by a manually operated valve in the cab.

This locomotive marks an interesting step in the development of heavy power for freight service. The efficiency of a locomotive for slow, heavy work, is measured largely by the proportion of the total weight that is available for adhesion; and in this respect the present locomotive excels, as about 90 per cent. of the total weight is carried on the driving-wheels, as against approximately 65 per cent. in a Mallet locomotive of the 2-8-8-2 type, including, in the latter case, the weight of the separate tender.

The following are the general dimensions of this locomotive:

Gauge, 4 ft. 8½ ins.

Cylinders—High-pressure, two, 36 ins. x 32 ins.; low-pressure, four, 36 ins. x 32 ins.; valves, piston, 16 ins. diameter.

Boiler—Type, conical; diameter, 94 ins.; thickness of sheets, 15/16 in. and 1 in.; working pressure, 210 pounds; fuel, coal; staying, radial.

Firebox*—Material, steel; length, 162 ins.; width, 108 ins.; depth, front, 87¼ ins.; depth, back, 68 ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ⅝ in.

Water Space—Front, 6 ins.; sides, 5 ins.; back, 5 ins.

Tubes—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; 2¼ ins., No. 11 W. G.; number, 5½ ins., 53; 2¼ ins., 326; length, 24 ft.

Heating Surface—Firebox, 272 sq. ft.; combustion chamber, 108 sq. ft.; tubes, 6,418 sq. ft.; firebrick tubes, 88 sq. ft.; total, 6,886 sq. ft.; grate area, 90 sq. ft.

Driving Wheels—Diameter, outside, 63 ins.; center, 56 ins.; journals, 11 ins. x 13 1/16 ins.

Truck Wheels—Diameter, front, 33½ ins.; journals, 6 ins. x 12 ins.; diameter, back, 42 ins.; journals, 9 ins. x 14 ins.

Wheel Base—Rigid, each group, 16 ft. 6 ins.; driving, 71 ft. 6 ins.; total, 90 ft.

Tank—Water capacity, 10,000 gals.; coal capacity, 16 tons.

Weight Estimated—On all driving wheels, 743,000 lbs.; on truck, front, 30,000 lbs.; back, 57,000 lbs.; total, 830,000 lbs.

Service, heavy pushing. Tender section driven by steam.

Locomotive equipped with Schmidt superheater. Superheating surface, 1,584 sq. ft. Tractive force, 160,000 lbs.

*Gaines furnace and combustion chamber. Length of grate, 120 ins.

Recorder Annunciator.

Safety of railroad travel is enhanced by a recorder annunciator invented and patented recently by Charles Edmonds, a mechanic in the shops of the Baltimore & Ohio Railroad, at Baltimore. The new appliance consists of a signal system attached to the speed recorder and located in the cab of the locomotive to notify the engineer that the speed limit of safety prescribed by the rules has been reached. The signals are indicated by a gong which rings in the daytime, supplemented by a light which flashes before the engineer by night. Both signals work automatically and continue while the train is running one mile and a half.

The device has been tested on several locomotives in regular service and has been reported upon favorably. The Baltimore & Ohio is considering installing the annunciator on its locomotives in through train service, which, with many of the engines used on local runs, are equipped with speed recorders which indicate the rate of speed and make a record for each mile the train travels. In adopting this method of train operation, the speed limits were fixed by the officials, and by informing the engineers it has been possible to operate the trains with the greatest degree of public safety and comfort.

Safety on the Grand Trunk.

That the safety committees of the Grand Trunk Railway are doing most effective work in the prevention of personal injuries is clearly shown by a statement just issued by Mr. Geo. Bradshaw, safety engineer of that system. From September, 1913, to February, 1914, inclusive, there was a decrease of forty-six per cent. in the number of employees killed and a decrease of sixteen per cent. in the number injured including all classes of injury serious or trivial, as compared with the corresponding months of 1912 and 1913. The safety movement was put into effect on the Grand Trunk in August, 1913

Erie to the Front.

According to the January report, issued by the Public Service Commission, the Erie Railroad maintained its record of having more trains on time than any other railroad entering Rochester. The percentages of trains on time for the five roads entering the city is announced as follows: Erie, 83 per cent.; Lehigh Valley, 81 per cent.; New York Central, 80 per cent.; Pennsylvania, 78 per cent.; Buffalo, Rochester & Pittsburgh, 77 per cent. A very considerable number of the leading railways in the United States and Canada approach these excellent records.

General Correspondence

Machinists' Wages in the North.

EDITOR:

We have been much interested in the discussion going on in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING in regard to the rates of machinists' wages, and while some of the letters seem to point to New England as being the lowest on the map, the most of the writers seem to take care not to mention the exact name of the particular shop where they are located. This is not to be wondered at, because one does not naturally desire to belittle his own locality. You will permit me to state that as far as the rate of wages paid to the New York, New Haven and Hartford Railroad is concerned, the wages will compare favorably with those prevalent in the Eastern and even in the Southern states. The standard minimum rate at present is 34½ cents per hour, graduating to 39 cents per hour, according to seniority and particular class of work on which the machinist may be engaged.

It is well known, however, that in New York City and vicinity the rates are even lower than that claimed by Mr. Richardson. This is the more remarkable as it is generally understood that the cost of living and other expenses are higher there than in what may be called the rural districts, where rents and some other expenses are not so high. Probably the low rates may be owing, as Mr Reardon stated, to the fact that there is a large influx of mechanics there, if one might call them mechanics, who have never served any regular apprenticeship, and who, perhaps, may be able to key up an ashpan or adjust a set of grates under the supervision of a skilled mechanic. Those men, of course, are of the unorganized type, and are glad to take anything that they can get, and the rates paid to them should not be looked upon as a fair estimate of machinists' wages.

Apart from this fact, however, the statistics collected from the entire country show that the average rate of railroad machinist's wages run from $2.98 to $3.14 per day, while that of engine men run from $4.44 to $4.79 per day. The engineers deserve all they get, but it will surely be conceded by any unprejudiced judge that the constructor or repairer of locomotives should be paid nearly as well as those who run the engine; the variation in favor of the engineers being that they are almost always compelled to spend a considerable portion of their time at some place or places remote from their homes.

In conclusion, therefore, while admitting that the rates of machinists' wages in the South may be exactly as stated, there must be a very large number of machinists employed elsewhere whose rates of wages are much less in order that the average rates remain as low as are furnished by the government's statistics, and let us hope that when an era of general prosperity shall again set in something of a substantial advance will be made all along the line.

J. R. ADAMS.

Providence, R. I.

New Instruction School.

EDITOR:

It may be of interest to learn that we have prepared an instruction school at Stamford, Conn., for the purpose of instructing engineers and firemen and any other employees on general instructions as to the operation of electric engines. There will also be instructions in the air brake, books of rules of the operating department and manual block, and automatic block signals. The instructions on electric engines will be conducted by Mr. J. C. Welch, our electric road foreman. Air brakes will be explained by Mr. C. U. Joy, our general air brake instructor. The book of rules and signals will be dealt with by a representative from the division superintendent's office.

There will also be classes in relation to the steam locomotive, which will be held on Wednesdays, Thursdays and Fridays of each week. The indications are that one of the most complete railway schools in America will be in full operation here in a short time, and the keen interest shown by the railway men in the matter is a sure guarantee that the educational facilities will be fully taken advantage of.

D. E. COOKE, General Foreman,
N. Y., N. H. & H. R. R.

Stamford, Conn.

Excessive Lead.

EDITOR:

Railway men, especially in the mechanical department, look to RAILWAY AND LOCOMOTIVE ENGINEERING for the proper information as to how to operate the modern locomotive in the most efficient and economical manner, and as an example the valuable information which has recently been given in reports of committees and other sources, and particularly the discussion last year, which was ably participated in by several correspondents, proved conclusively that better results are obtained in running a high-powered locomotive by using a longer cut-off and a lighter throttle than by a short cut-off and a full open throttle.

Coming to the matter of lead, or the amount of opening of the steam port at the end of the piston stroke, there is, I think, much waste of power in excessive lead. In the March issue of your magazine there is a description of a Pacific type of locomotive having cylinders 25½ inches by 28 inches; and piston valves 14 inches, with 3/16 inch lead. Cutting off at 6 inches, if my calculations are correct, the steam port will begin to open as the piston is about 5 inches from the center of the ports, and cutting off at 6 inches, making a total of 11 inches, thereby admitting almost as much steam, which cannot do other than retard the motion, as there is admitted after the piston has passed the dead center; that is, the port will begin to open at nearly 5 inches before the end of the stroke, and close at 6 inches after the stroke has begun.

If this is so, or nearly so, is there any wonder an engineer is in doubt whether he is backing up or going ahead when he tries to be economical in the use of fuel? The valves, I think, should be set line and line, that it with no lead or opening when the piston is at the end of the stroke, and inside lap, ⅛ inch. We will then have increased each leg of the valve ¼ inch, and at 8 inches cut off there will be at least one quarter more steam in the cylinders to do work with, and have used one-third less steam out of the boiler, and have about two inches longer piston travel for expansion of steam, which will reduce pressure and give lighter exhaust. Compression will begin earlier, which will be only sufficient to stop or cushion reciprocating parts at end of stroke. Some of the reasons why I make this assertion. Main pins running hot, excessive strain passing center, main driving box brasses badly worn at sides before crown is worn out, any number of driving axles broken on engines using excessive lead to valves, and many of the railroads can show you an expensive coal record, all due to the same trouble.

WILLIAM H. W. ROBERTS.
Cincinnati, Hamilton & Dayton Ry., Cincinnati, Ohio.

Disc Valve Jig and Renewing Locomotive Air Pump Strainer.

BY J. A. JESSON, LOUISVILLE & NASHVILLE RAILROAD.

Until recently, injector valve discs have been worked over in the lathe. The tool shown in the drawing was developed for

doing the work by hand; its advantages are obvious.

Fig. 1 shows a valve disc *B* screwed into a mandrel *C*. Mandrel *C* is screwed into jig body *D*. Reamer *A* is a neat fit in the bore of body *D* and is fed by nut *E*, acting against a ball thrust bearing *F* for reducing friction and to prevent the feed nut feeding automatically.

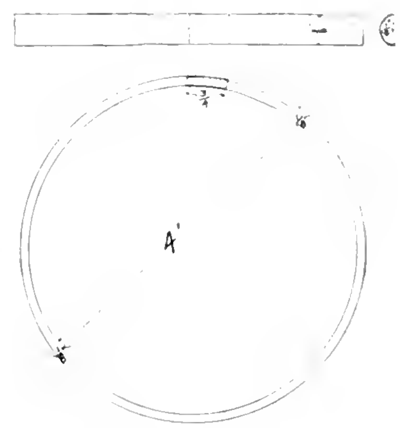
The peep-hole *G* is of ample size for observing the operation. This jig can be used for most any type of valve disc, it only being necessary to make a mandrel to suit

sprung over the plate and body and tightened in place with a suitable clamp, and then the ends are securely soldered together.

Tightening a Loose Crank Pin.

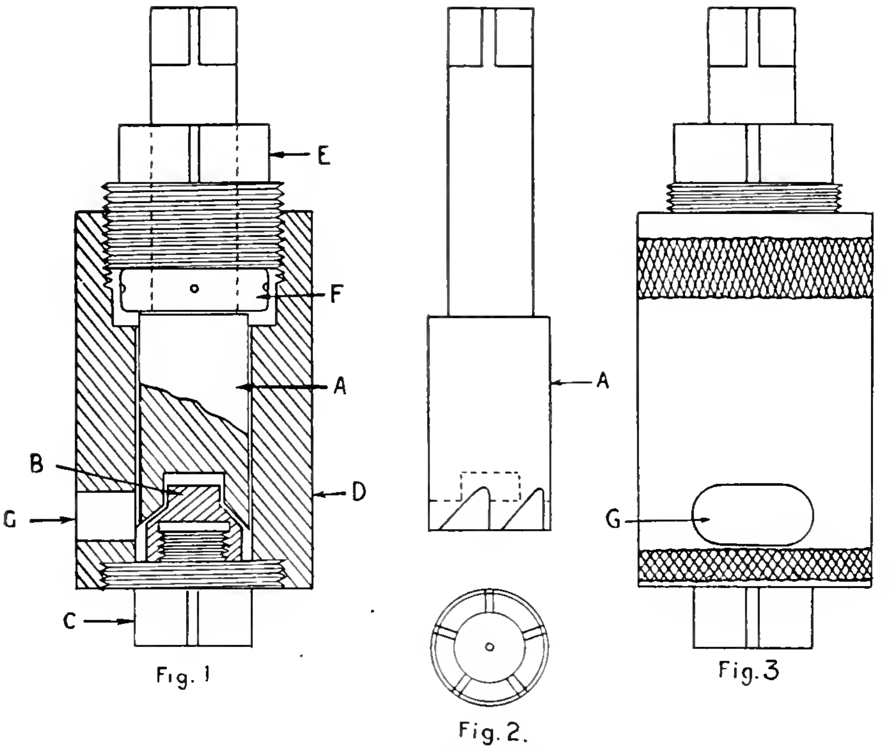
By R. S. Booth, Hickory, N. C.

Several weeks ago a small railroad that has practically no repair facilities sent us one of their locomotives with a loose main crank pin to be repaired. They had to bring the engine 95 miles to our shop, and before the engine had



BAND FOR AIR PUMP STRAINER.

of two eccentric straps and one pedestal brace, and the engine started away within a few hours of its arrival.



DETAILS OF INJECTOR DISC VALVE JIG.

By working these reamers in connection with a valve seat (male) reamer little or no grinding is necessary.

The strainers used on locomotive air pumps very frequently find their way prematurely to the scrap heap on account of the fact that there is no efficient method of renewing the plate. Renewing the strainer costs about thirty-seven cents. The accompanying drawing and photographs show a method of repairing the strainer and making it as good as new at a cost of about six cents.

It may be noted that when the perforated plate of the locomotive air pump strainer needs renewing, the construction of the strainer is such that it does not permit of its being replaced as it originally was. The method that I have successfully applied is to cut off the bead that was originally spun over the edges of the plate. Then have a tin band that is rolled out with its edges turned, as shown in the drawing, the ends of the band are left long enough to over-lap each other enough so that they may be readily soldered together. The tin band is

arrived the officials of the road were wiring to our master mechanic to return the engine at the earliest possible moment. After making an inspection of the crank pin it was found to have worked out about 1¼ ins., but was not damaged in any way, so it was decided not to remove it, but to save it, and thus save at least two-thirds of the necessary labor.

Five 1 in. holes were drilled in the wheel fit from the inside, with outside of holes ¼ in., from outside of pin fit and taper pins 6 ins. long, and 1/16 in. larger than the hole with 3/32 in. taper, were turned for them, and driven in with a heavy ram from the opposite side of the engine, thus expanding the wheel fit, and making it secure to wheel center. After this holes were drilled on a circle in end of pin, leaving ¼ in. outside of holes. The bridges were chipped out with an air hammer, which left a good projection to be riveted in countersink of wheel center, which was deepened befor driving the pin back to place.

The only tearing down that was necessary to do this work was the removing

Properties of Superheated Steam.

By Robert W. Rogers, Apprentice Instructor Erie R. R., Port Jervis, N. Y.

Through superheating steam it is made into a perfect gas, which under constant pressure is of greater volume than saturated steam.

The increase in volume is nearly proportional to the absolute temperature 460 degs. F.

Highly superheated steam behaves like a gas, and can work by expansion without condensation.

The greater volume of superheated steam makes it possible to use less weight of it to fill a like volume as compared with saturated steam.

The total heat per cu. ft. is less than that of saturated steam per cu. ft. at same pressure in spite of the fact that the specific heat increases.

The higher the superheat the greater is the advantage to be gained, 570 degs. F practical limit of temperature at valve chest.

Steam of low or high pressure can be superheated to same temperature.

It is practically possible to use a much lower pressure to advantage with superheated steam than is to be attained by saturated steam, and in fact it is hard to realize a like advantage.

Superheated steam is practically a non-conductor of heat acting as an insulator.

Superheated steam at 13 atmospheres

TIN BAND IN PLACE IN AIR PUMP STRAINER.

or 184.6 lbs. absolute and 200 degs. F. superheat, there is an increase in volume 23.6 per cent., but this does not neces-

sarily call an increased boiler capacity to that amount. The actual case in practice is that a cooling effect of the cylinders decreases this volume. Another point the expansion of superheated steam is more rapid than that of saturated steam; therefore, a longer cut off should be used than that used for saturated steam locomotives for the same power when the cylinders are of like dimensions (increased size of cylinders is better practice).

Even considering that less steaming capacity is made by applying the superheater, this is made up by the saving in steam through the increased volume at time for admittance of steam to the cylinder, and in practice from 15 to 30 per cent. saving made in the use of steam owing to the elimination of consideration.

Tests show that in Mallet Compound engines without superheater the condensation is 20 per cent., while in simple saturated engines using short cut-off cylinder condensation runs up to 35 per cent. of the volume of the steam. This means that for every 100 lbs. of steam delivered to cylinder only 65 lbs. are available for producing work. The superheater saves that or 35 per cent. in water and 25 per cent. in the amount of coal.

Forcing a superheater increases the efficiency.

Neither steam nor coal consumption is materially affected by considerable changes in boiler pressure, a fact which justifies the use of comparatively low pressures in connection with superheater

SIZE OF SUPERHEATER REQUIRED.

Taking steam at 170 lbs. gage as generally recommended to use, and 200 degs superheat and 0.93 dry or having a quality of 93 per cent. Steam at 185 lbs. absolute has 1196.3 B.T.U. total heat, 348.1 B.T.U. heat in water, 848.2 B.T.U. latent heat.

	B.T.U.	B.T.U.
Thus the heat required for boiler heating surface per lb. of steam will be 0.93 x 1196.3 or.................	1111.0	
And 0.07 lb. water at saturation temp. 0.07 x 348.1 or.	24.4	
		1135.4

HEAT REQUIRED FOR SUPERHEATER.

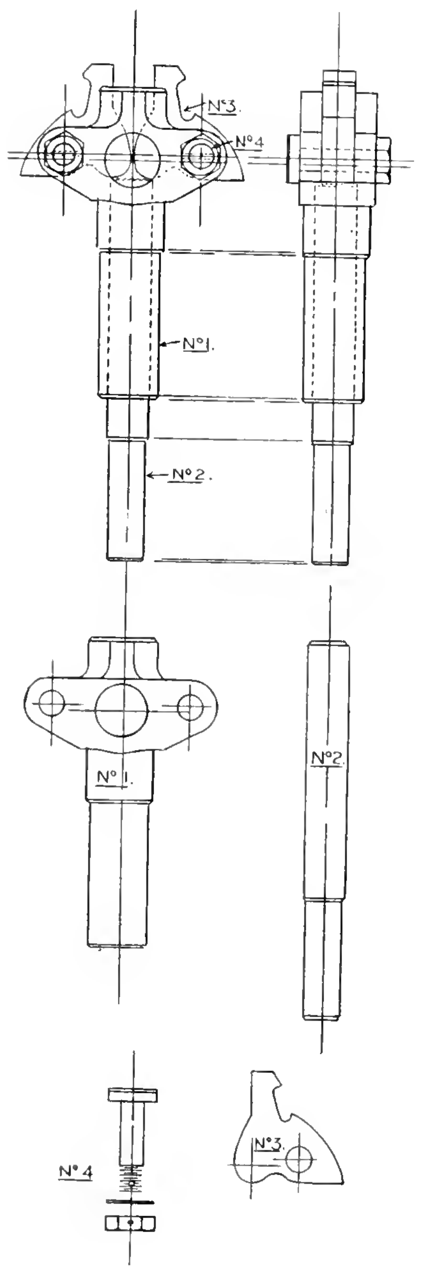
Evaporation of 0.07 of water at 375.1 degs. F., 0.07 x 848.2 or	59.5	
To superheat 1 lb. dry steam 200 degs. F., 0.541 x 200 degs or	110	
		169.5
Total heat required per lb. of superheated steam at 575 degs. F.		1304.9

The superheater requires 169.5 B.T.U. or 13 per cent. of this.

On considering that an up to date locomotive boiler generates 40 per cent. of its heat in fire-box and 60 per cent. in tubes; therefore, it is clear that superheater will take up: 13 per cent. of 60 or 22 per cent. of flue heating surface.

INCREASE IN HAULING CAPACITY.

In actual practice economies in coal consumption for same class of locomotive using the above pressure both with and without superheat a total gain of 18 per cent. in fuel and water consumption has been made—that is for like sizes of engines—we would get $\frac{100 \times 100 - 82}{82}$ = 22 per cent. greater haul, or taking into consideration that 60 per cent. of indicated horse power is all that is generally available for draw-bar pull $\frac{22 \times 100}{60}$ = 36.6 per cent. gain in general efficiency at draw-bar.



DETAILS OF COMBINATION FLUE EXPANDER, PROSSER AND BEADING TOOL.

CYLINDER CONDENSATION.

The saving that is effected by preventing cylinder condensation by use of superheated steam varies from 12 to 35 per cent., according to point of cut-off; the shorter the cut-off the greater the saving.

INCREASE OF SIZE OF CYLINDER.

The cylinders should be increased from 10 to 15 per cent. in size, depending on degree of superheat.

General Remarks on Design and Operation:

1—The temperature should increase with demand of engine.

2—The superheater elements be thick walled tubes, but sub-divided.

3—To completely use the steam current they should be compelled to repass through the tubes.

4—The draft should be able to be regulated at will.

5—The maximum tractive effort should exist at 45 per cent. cut-off; and cut-off should not be decreased below 20 per cent.; below this limit the power should be controlled by throttling steam supply.

6—To insure an elimination of condensation steam chest temperature should be 575 degs. F., as proved in practice by repeated test.

Combination Flue Expander, Prosser and Beading Tool.

By E. E. Stillwell, General Foreman Boilermaker, Ferrocarril Mexicano, Orizaba, Mexico.

The accompanying drawing shows the details of a tool which I have just perfected, and the invention provides in one single tool the means for quickly and efficiently making boiler flues ready for service. The work accomplished by this tool is now being done by the use of three different tools of various makes, including flue expanders, flue prossers, and flue beading tools. The tool may be operated by a small air hammer or electric hammer. It is simple of operation and can be readily operated by any boiler maker, or apprentice of short experience in a boiler shop. The size shown in the drawing attached is the size to be used for flues 2¼ ins. in diameter, but it can be made in any size desired up to flues that may be 6 ins. in diameter.

Fig. No. 1 is a view of the frame, No. 2 the piston, No. 3 a longitudinal sectional view of the tool, and No. 4 the combining bolt and cotter key.

It is hardly necessary to explain that in operation when the device is placed in

the boiler tube that by striking the reduced cylindrical end of the plunger with a hammer of any suitable type the cam surfaces which rest against the end of the plunger will be forced outwardly, which will cause the expanding elements to engage the inner wall of the boiler flue and force the same outwardly. At the same instant the beading elements will engage the outer end of the boiler flue and flange the same outwardly, thus firmly securing the tube in the boiler sheet. The flat bottom wall of the recess will engage the inner wall of the flue and thus force the flue into frictional engagement with the wall of the aperture in the boiler sheet and form a water tight joint.

Changes may be readily made in the combination and proportion and arrangement of the parts as may be desirable to suit the particular boiler or flue without departing from the spirit and scope of the invention. In actual tests the tool has accomplished twelve times as much work as by the ordinary method with a variety of tools, and it is particularly effective in repair work.

A Veteran French Locomotive.

By M. Genet, Nancy, France.

It is always gratifying to see in your pages some space devoted to curiosities in locomotives, early pioneers, war relics, curious models and the like. On the Eastern Railway of France we have quite a number of locomotives that would seem strange to Americans. Enclosed is a photograph of what is known as a Crampton passenger locomotive. It is of the 4-2-0 type. This kind of locomotive was once quite common on French railways, but has given way to modern types. Apart from the outside frames which it may be noted are of the most substantial kind, the most peculiar feature is the large main driving wheel to which are attached outside eccentrics for actuating the valve gear. While the tractive power of these locomotives is not great they are capable of a high degree of speed and suited the light passenger traffic. Whether it is that the light service has not much effect on their wearing parts, it is a fact that in the element of durability these small engines outlast several of the modern high powered locomotives.

The workmanship is of the best, and as is the case with nearly all kinds of machinery used in France, the finish is of the finest. The French railway men excel in keeping the bright work bright, and while this old type of locomotive does not in any degree represent the fine class of locomotives used in France generally, it has the same marks of elegant finish peculiar to the French locomotives.

The general dimenisons of this type of locomotive are: Cylinders, 15¾ ins. by 22 ins.; diameter of leading wheels, 4 ft. 6⅜ ins.; intermediate wheels, 4 ft.; driving wheels, 7 ft. 7 ins.; boiler pressure, 128 lbs. Heating surface: Firebox, 69.86 sq. ft.; tubes, 876 sq. ft. Total, 946 sq. ft. Grate area, 13.12 sq. ft. Wheel base, 14 ft. 9¼ ins. Length over buffers, 25 ft. 5 ins. Weight in working order, 34 tons, 3 cwts.

Elementary Heat Problems.

By Angus Sinclair.

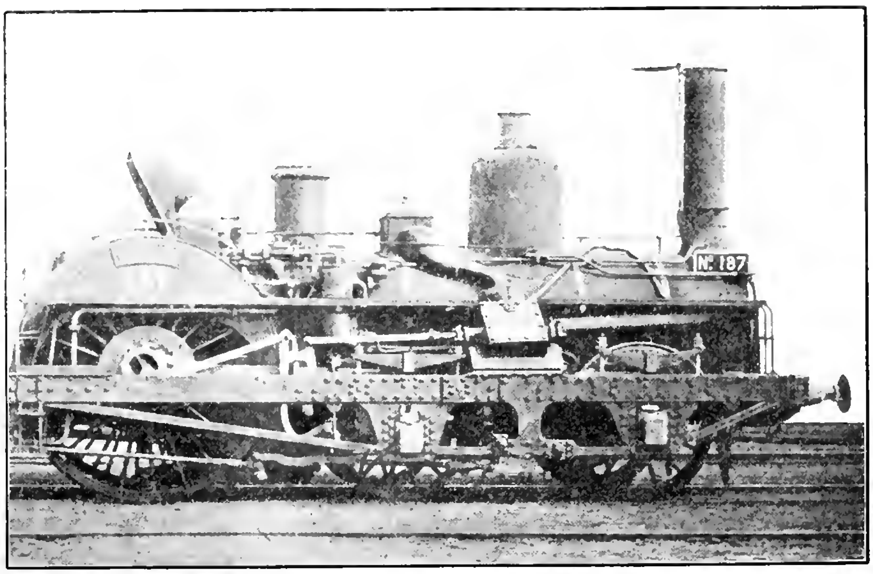
The burning of fuel and the boiling of water into steam are the fundamental processes by which the dormant forces of nature are converted into the power that performs the heavy labor that carries the burdens of mankind. To keep a fire hot so that it will cause a kettle to boil seems a simple operation, yet every one who has to pay the bills for kitchen fuel knows that to produce the same result some firemen of this most simple kind of furnace burn more fuel than others. When we find the fire grate or stove developed to the furnace of a large boiler or the firebox of a heavy locomotive, the difference of the fuel used by a good and a poor fireman becomes a very serious matter. We know of no line where the power of knowledge is likely to effect so much saving for steam users and of the fuel treasures that have been laid up for the use of man as in the spread of information relating to the laws of combustion.

The burning of fuel being a chemical operation, the subject cannot be properly understood without some insight into the science of chemistry as it relates to combustion. To those whom the word science frightens, it may be well to mention that science is merely accurate knowledge. Those who have no inclination to follow the best way of doing things, generally have contempt for everything of a scientific nature. Knowledge and the sense to apply it make a strong combination and produce the man of ability. Science or knowledge does not, however, always bring wisdom. There is truth in Pope's lines on the Seven Sciences:

Good sense, which only is the gift of
 Heaven,
And though no science, fairly worth the
 seven.

It is much better to have an engineer or fireman with good sense and no science, than one with much science and no sense. But the man having both is certain to be of greatest value to an employer and to himself.

In treating of combustion and steam making I will frequently have to refer to the laws of nature. Everything in nature is guided by a mysterious power which controls and regulates its formation, growth or action. For want of a better description this power is called the laws of nature. When a seed is put into the ground it produces a plant after its kind; when steel is poured into a mold the molten metal will cool into a very hard substance; when molten lead is treated in the same way the product will be a soft casting. If a piece of wood or coal is raised to a certain high temperature in the presence of air it will burn. If the gases hydrogen and oxygen come together at a high temperature they will join into one gas and become steam. If that gas is reduced below the temperature 212 deg. Fahr. it will become water. If the water in turn is subjected to cold greater than 32 deg. Fahr. it will become ice. All these changes come about in obedience to the laws controlling the different substances. We know nothing of how the laws of nature were established and we are ignorant of how the power is applied that enforces them; but the human mind can conceive of nothing



4-2-0 CRAMPTON PASSENGER LOCOMOTIVE. EASTERN RAILWAY OF FRANCE.

more absolute than their action. From the daily rising of the sun and the regular movements of other heavenly orbs, to the more familiar sight of how a seed produces its own leaf and how the frozen rain-drop forms a crystal of a certain shape, all are illustrations of the exactness of the immutable power that rules the universe.

Everybody is familiar with the sensation of heat, but how the sensation is produced is not popularly understood. A fire burns and it gives forth heat, the sun's rays are warm to the touch, the hand of a vigorous man feels warm, and the turnings that fall from a lathe tool making a deep cut are hot enough to burn the fingers. These are all different manifestations of heat. How are they produced?

The question is as old as scientific speculation. Few subjects have received more attention from philosophers. Up to the beginning of the present century heat was supposed to be of a kind of subtle fluid which had no weight and was capable of insinuating itself into the inmost recesses of all visible matter. This fluid was supposed to have taken up its favorite residence in all kinds of fuel and was resting in a semi-sleeping condition, awaiting the kindling spark to bring it into intense action.

Experiments were made by Davy, in the last year of the last century, which led to a thorough scientific investigation of the subject by the ablest philosophers of modern times. By rubbing together pieces of ice, Davy demonstrated that heat could be produced by friction. Others proved the case even more conclusively. The discoveries subsequently made have led to the establishment of what is known as the dynamic theory of heat. This theory holds that heat is a form of energy, and that it is caused by intensely rapid vibratory motion of the molecules forming the heated substance. According to this theory, heat, light, electricity and chemical action are all merely different manifestations of matter in motion.

Heat is measured by what is called the thermal unit or heat unit. After a long series of experiments conducted with extraordinary care and exactness, Dr. Joule, a famous English physicist, discovered that the amount of heat required to increase the temperature of one pound of water one degree Fahr., represented energy sufficient to lift a weight of 772 pounds one foot. This is known as the heat unit, and is used in reckoning the value of fuel and for many other purposes relating to heat and steam. Later investigations proved the heat unit to be 778 foot-pounds.

The energy of heat is estimated by its power of doing work. In physical science the term work means the overcoming of resistance of any kind. All operations performed by animals or machines requiring the exertion of power is classed as work. Heat may be transformed with work and work changed into heat. The science relating to the conversion of heat into mechanical action is called thermodynamics, and its first law says: "When heat is transformed into mechanical energy or mechanical energy into heat, the quantity of heat equals the mechanical energy." This is a scientific law that every one studying steam engineering ought to commit to memory.

If an iron rod set on an anvil is struck several sharp blows with a hammer it is made hot. The mechanical energy represented by the descending hammer is converted into heat. If an ordinary drop-hammer is employed the amount of heat generated is the same quantity that would be required to raise the hammer to the point from which it fell.

Work is measured by foot-pounds, or the amount of labor represented by the raising of one pound one foot high. The work done by machinery and engines is generally estimated by the horse power, which is equivalent to the raising of 33,000 pounds one foot in one minute. It does not matter in what direction the power may be applied. It may be 330 pounds raised 100 feet in one minute or the height and distance may vary to any extent so long as the unit is 33,000 of weight by pounds and feet performed in one minute. The weight may be pulled or pushed horizontally, or moved at any angle from the perpendicular and the result will be the same so long as the pull or pressure represents 33,000 pounds with the distance in feet traversed in one minute.

When the demands of a growing business required that James Watt, the famous engine improver, devise some method of measuring the power of steam engines, he thought of several plans, but finally decided that horse power would be the most comprehensive. Nearly everybody knew in a loose way something about the load a horse would haul, so Watt proceeded to find out with exactness the hauling capacity of the horses in his neighborhood. Experiment proved that an ordinary horse would put a strain of about 220 lbs. upon the traces of a wagon and travel at the rate of 100 ft. per minute. That was the equivalent of raising 22,000 lbs. one foot per minute, and was in its day known as the actual horse power. Business was very dull in steam engine building at the time this investigation was made, so Watt and his associates, in order to stimulate business, began offering to sell engines with horse power reckoned at 33,000 lbs. raised one foot per minute. Of course, engine purchasers readily accepted this inducement, but it proved like many other cases of breaking prices, much more easy to reduce than to restore. So in the course of time the standard horse power of all nations became 33,000 foot-pounds.

It is a common thing to find a locomotive that is capable of exerting a pull of 16,500 lbs. of the draw-bar when running at a slow rate of speed. An engine keeping up this pull at a speed of ten miles an hour exerts 440 horse power.

In connection with elementary mechanical questions an interesting problem for railroad men to solve is the foot-pounds of energy in a moving train and the heat units represented by the conversion of mechanical energy into heat when the train is suddenly stopped. When the losses from friction and air resistances are eliminated, it takes exactly the same amount of energy to stop the train that it takes to force it into speed. Suppose a train of one engine and seven sleeping cars, the whole weighing 600 tons, is running sixty miles an hour, required the energy of the moving mass and the heat unit represented by its conversion into heat? The problem is stated algebraically, $\frac{w \times V^2}{2g}$, in which w is the weight of the train, multiplied by V^2, the square of the velocity, and divided by 2 g, twice 3.16 the velocity, which a falling body acquires at the end of one second. The weight of the train is 120,000 lbs., the speed is 88 ft. per second, so we have the problem arithmetically:

$$1{,}200{,}000 \times 88 \times 88 \div 64.32 = 144{,}477{,}600 \text{ foot-pounds.}$$

That is the energy in the train regarded as a moving body like a huge shot. But something else has to be considered. Each wheel in the train has revolving momentum in itself similar to the inertia of a revolving fly-wheel, and this course of energy has to be calculated, because it tends to keep the train in motion and is an important portion of the momentum to be overcome in the stopping of a train.

The tread of the wheel has the same velocity as the train. This is called the angular velocity of the wheel. If all the weight of a wheel were at the circumference it would be easy calculating the momentum. But as the weight extends from the center of the axle, where movement is imperceptible, to the tread, where the velocity is the greatest, the energy of rotation has to be estimated from a point called the center of gyration. To find this point with exactness is a complex problem, but it is near enough for practical purposes to assume that the center of gyration of a car wheel is at a distance of one-fifth of its radius from the circumference. The angular velocity of the wheels of our train is, therefore, four-fifths of the speed of the train.

Our whole train has about the following wheel and axle weights:

	Lbs.
7 Sleepers, 42 wheels, 21 axles, total weight	37,800
12 Small wheels of engine, 6 axles, total weight	19,200
4 Driving wheels of engine, 2 axles, total weight	6,000
Total	63,000

The velocity of our train was 88 ft. per second. We have now 4/5 of 63,000 pounds to be calculated in the same way as the energy of the train was figured out. The problem is 63,000 × 4/5 × 88 × 88 ÷ 64.32 = 6,040,000 foot-pounds. This sum added to the energy of the moving train previously found, makes a grand total of 150,517,600 foot-pounds. This sum divided by 778, the number of foot-pounds in a unit of heat, gives 193,467 heat units, into which the mechanical energy of the train will be converted in stopping.

Favoring the Brick Arch.

The introduction of the brick arch to locomotive fireboxes has made more progress in the last five years, than it did during the whole of the time previous that locomotives were operated in the United States. At various times there was agitation started in favor of the brick arch, but its advocates by degrees became apathetic and a valuable aid to combustion was permitted to drop into desuetude. As long ago as 1880 James M. Boon, master mechanic of the Pennsylvania Railroad at Fort Wayne, who was one of the ablest master mechanics of his time, wrote to the Master Mechanics' Association about his experience with the brick arch as follows:

I have used the brick arch with hollow staybolts. The first row of these bolts was 7 inches above top of grates, the next row 4 inches higher. The holes were three-eighths of an inch in diameter. There were 62 in all. With this arrangement we found that we could get about seven miles more to a ton of coal than could be made with the same engine without the arch and with the hollow stays plugged. The combustion was almost perfect. If properly fired there would be no smoke from the stack. While we were using the brick arch we were having considerable trouble with firebox sheets cracking, and we thought the arch might in part cause the trouble and abandoned it. I was at that time and am now very favorably impressed with the brick arch and believe that with the firebox steel now being manufactured there would be no cracking of side sheets.

It will thus be noted that Mr. Boon's opinions in regard to the brick arch, though formed thirty years ago, were correct in the estimate of its efficacy.

On the Oregon Short Line Railroad

As the summer approaches, the great Northwest comes into sudden prominence not only as the resort of the pleasure-seeking tourist, but as the available region for the homes of actual settlers. When the railroads first opened up that vast territory it was necessary to pass over large tracts of land of such a kind that much of it was considered unfit for cultivation. Means and methods of irrigation have changed all this and portions of the country that were once looked upon as hopeless deserts are now being rapidly brought into use. This is notably the case on parts through which the Oregon Short Line passes. The accompanying illustration showing a view of the Bear River Canyon, Utah, on the main line of the Oregon Short Line Railroad, between Salt Lake City and Butte, Mont., being located about forty miles north of Salt Lake City. This canyon is only about two miles in length, but is very rugged, picturesque and awe-inspiring in the extreme. The stream of water shown at the left of the picture is the Bear River Canal, an irrigation enterprise ditch which starts at the bottom of the canyon, getting its water from the Bear River, and graduates south along the edge of the mountain until it reaches the rich and fertile Bear River Valley plateau, beyond where it serves to irrigate and make fruitful thousands of acres of land once dominated by sage brush. One of the numerous power and light plants of the Utah Power & Light Company is located in this canyon, furnishing electrical power and light to a wide territory.

BEAR RIVER CANYON, UTAH, ON THE OREGON SHORT LINE.

Pacific Great Eastern Extension.

The recent authorization of the British Columbia Legislature for the extension of the Pacific Great Eastern Railway from its present objective, Fort George, northword and eastward through the Rocky Mountains to the Prairie Provinces, is one of the most important of recent years in the development of the natural resources of the Province. The road will tap and open up for settlement the Peace River valley country, a territory estimated to contain 31,500 square miles, equal to 20,000,000 acres.

General Foremen's Department

Copy of Letters Issued from the Office of Mr. Wm. Hall, Secretary-Treasurer of the International Railway General Foremen's Association.

I.

The convention season for 1914 is fast approaching, and preparations are already being made by the various associations for holding their annual gatherings, so we thought that a line to you in connection with the International Railway General Foremen's Association, would be timely.

Last year we sent out an appeal to each and every superintendent of motive power, throughout these United States, and am pleased to say that the responses received were very gratifying and encouraging, assuring us of their appreciation of the need of such an organization in the railroad world.

Quite a number of these superintendents caused circular letters to be sent to the general foremen on their several systems, calling their attention to the association, and stating that if any of them wished to ally themselves therewith, it would meet with their approval.

The results were in a measure very gratifying, but we have reason to believe that if the superintendents had gone a step further and had stated that the time spent at the convention would not be deducted from their annual vacation, our membership would have been increased 50 per cent.; and when we say this we speak advisedly; as a large number of the general foremen have said that they would like to become members, but they do not feel that in addition to defraying their own expenses, the time should be deducted from their vacation.

The International Railway General Foremen's Association is a business proposition, pure and simple, and entirely in the interest of the railroads, so we are sending out this, our second appeal to you, soliciting your further interest in our association, and would respectfully request you to inform your general foremen, that if they see fit to become members, and attend the conventions their time will not be deducted from their vacation period; and that (if you will pardon the suggestion) a limited expense account would be allowed.

If the above suggestions are acted upon with favor, and to be assured that the man was in attendance at the sessions of the convention require a report from each man, thirty days after his return, and in a given time, some results; for after consulting the topics for discussion in the margin you will agree with us when we say that any man that cannot learn something to his advantage from these conventions is in the wrong place as a general foreman. These conventions cannot help but broaden his mind, and he will learn of improved methods of doing work, and will tend towards greater efficiency.

II.

The International Railway General Foremen's Association is now recognized as one of the leading organizations in the railroad field, by the mechanical press and by the officers higher up. The field covered by this association is an important one, and one not covered by any of the other numerous mechanical associations. It is generally conceded that no association has better or more timely papers, on subjects of interest and importance than are presented and discussed by members of the General Foremen's Association. At the annual meetings of this association, ideas can be gained and carried home, and in a short ime can be made to show in dollars and cents. New methods and shop kinks are gleaned, not only from the discussions of the various timely subjects but by the interchange of ideas, in conversation outside the convention hall, by meeting the different supply men and viewing their exhibits, which are a school of instruction in themselves.

If you wish to improve your shop methods, and increase your usefulness to the company you serve, you can find no better medium than the General Foremen's Association for acquiring more knowledge in your line of business. The object of this letter to you is, if you are already a member, to impress upon you the importance of attending the conventions, and thus giving the officers of the association your personal support, and if you are not a member, to request you to make out your application and send it in today, to the secretary, who will see that you are properly enrolled, and placed upon his mailing list for future literature.

The general foreman of today is the shop superintendent or master mechanic of tomorrow; and if you are ambitious, and have set for your mark the highest rung in the ladder, don't fail to attain a membership in this important organization, and having once attained it, don't neglect to maintain your membership.

Improved Methods and Best Way to Acquire Them.

By Wm. Gale, Machine Foreman, Chicago & Northwestern Ry., Chicago, Ill.

The benefit to be derived from railroad clubs and kindred organizations is apparent from the fact that representative motive power men thereby keep in touch with the best thoughts and practices that pertains to the success of their occupation. It is particularly gratifying to note that in our day the tendency to conceal mechanical devices has entirely passed away, and the best mechanics seem to know and feel that it is a duty to present the results of their practical experience for the benefit of their fellow workers. The highest degree of efficiency is now demanded by modern conditions. Old methods are no longer available, and a complete mastery of the scientific details that are applicable to motive power requirements can only be learned by observation and coming in contact with others who are working successfully in the same direction.

The tremendous power and speed exerted by the modern locomotives of today in order to meet the requirements of vast population, and the long distances traversed by the railroads, is full of many complex conditions, largely mechanical in their composition and execution, details that can be solved only by earnest men who take every opportunity to familiarize themselves with the best methods of meeting the conditions that have arisen.

The General Foremen's Convention affords an excellent opportunity to those interested in the work referred to. The men of experience have an opportunity to explain the latest and best methods in shop output, roundhouse practice, apprenticeship problems, superheating appliances, specialization of men and work, as well as the best rules and regulations pertaining to the same. The action of the convention will be a reflex of the best thought on matters pertaining to the above, and the general foremen from motive power plants are invited to be present and to take part in the discussions.

Lining Shoes and Wedges.

By A. E. Scheetz, Shamokin, Pa.

In the matter of lining up shoes and wedges there are a variety of methods in vogue and it would be interesting to have an exchange of opinion as to what is the way of getting correct results. In some

shops they line the wedge only, in other shops they divide equally the lining between the shoe and the wedge and still others they line most any old way.

In regard to the first method all shoes and wedges do not wear equally the tendency is for the main to wear the hardest, then by lining all on the wedge throws the wheels out of tram; this starts up a pound that is almost as bad and sometimes worse than if the wedge had not been lined, caused by the rods crossing

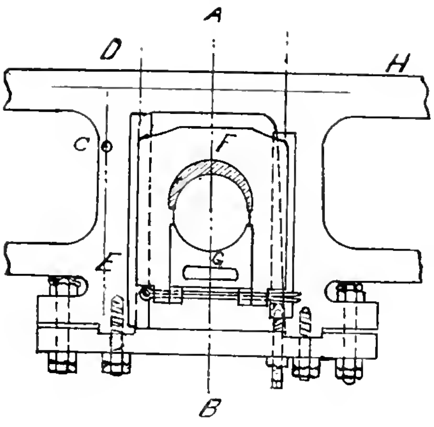


Fig. 1.

the centers. Taking the second method this might be an improvement, but I have taken down shoes and wedges that the wedge was worn more than twice as much as the shoe, so by lining equal throws the wheels out of tram again. The third method is little better and sometimes worse than no lining, as it is often put in according to the judgment of the party doing the work.

Now, I have often noticed that when engines are given light round house repairs, such as lining up shoes and wedges, new main boxes and shoes and wedges, new brasses in the other boxes, new rod brasses and new knuckle pins and bushings, that they sometimes pound severely. This is very often caused by the engine being out of tram.

Now to find a remedy, first we have the tram and say we are going to use it and say both main has been lined up by placing the liners on the wedge, this probably will throw the wheels close to tram. We try the tram and find that the main and intermediate tram all right on both sides, that is, they are the same distance apart, so are all the rest of the wheels, each pair tramming equally on opposite sides. But how do they compare with their respective rods? Remembering that the rods have not been changed and they are fitted with circular brasses.

Now, I suggest that when the engine is built or when it gets general repairs and the square centers have been located as well as the journal centers of the other jaws, that a point be located a certain distance, back or ahead, and a certain convenient distance from the top, as show at C in the sketch, Fig. 1. This to be located on the inside on the pedestal leg, and to be surrounded by a stamped circle, like a proof circle, or a point put on a small cap bolt which is screwed into the frame. Then plane a sharp line through the center of the inside face of the box, as shown at A B, and also across the cellar. Then by striking a perpendicular line through C as D E perpendicular to D H. Then by taking a small tram equal in length to the distance between C and the line F G, it will be an easy matter to determine at any time and at the cost of but a minute's time the proper position of the center of each journal. This will insure all drivers being in tram, and will give the working men a ready means to determine how and where to line, also in renewing boxes, shoes and wedges it will instantly give the square centers by using a proper tram. The shape of the tram would be for the boxes, as shown in Fig. 2. The difference in the length of the legs, A and B, depending on the thickness of the box and the amount extending on the inside of the frame and the shape for square centers of the jaws would be a tram of proper length with equal length legs, A and B, Fig. 3. This method could be applied to most all engines by placing the center C, Fig. 1, to either front or back of the box for convenience sake. I have examined quite a number of engines and find that it can be used on all that I have examined.

You might say that it is not practicable on account of the box working up and down in the jaws. No matter where the box is, up or down, you tram the shortest distance to the line on the box.

It might be said that the box may be cocked. Then you tram from two places, taking a point on the perpendicular D E

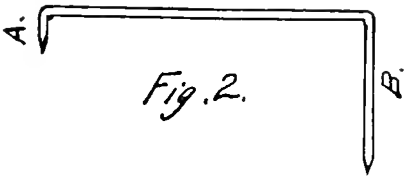


Fig. 2.

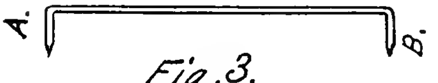


Fig. 3.

through C to the line on the cellar. The box might be bored out of center, but this will not occur with reasonable care, and with any kind of inspection would be detected. Standard trams should be used as in valve setting. This would stop quite a few pounds that now are hard to find, for, I believe, that many a broken pedestal leg or frame, broken shoes and wedges, broken parallel rods, and even broken crank pins can be justly blamed on the drivers being out of tram with the rods.

Waterpower of the World.

In a summary of the waterpower of the world the possible horsepower of France is estimated at 4,500,000, of which only 800,000 is utilized. About an equal amount of power is available in Italy, but only 30,000 horsepower is utilized. Falls of 10,000 horsepower are abundant in the Alps. The estimate for Switzerland is incomplete, but about 300,000 horsepower is in use. Germany has 700,000 horsepower available, with 100,000 applied. Norway has 900,000 horsepower vailable, with a large part already developed. In Sweden there is 763,000 horsepower available, but mostly at a considerable distance from any industrial center. In Great Britain there is 70,000 horsepower already utilized, and an equal amount in Spain. The resources of Russia are estimated at 11,000,000 horsepower, of which only 85,000 has been developed. The United States is credited with 1,500,000 horsepower, while Japan has 1,000,000, of which 70,000 has been exploited; and in India 50,000 horsepower has already been developed.

To Keep Carriage Doors Locked.

There has always been difficulty in keeping unauthorized persons from opening the doors of the compartment cars used on European railways. Now it is reported that the difficulty has been overcome by the invention of a signalman. A special cable dispatch to the New York *Times* reads:

"One of the principal railway companies has paid a young signalman, George Caswell, $95,000 for his invention of a safety lock for railway carriages.

"The invention makes it possible to lock the doors of all the carriages in a train by a lever controlled by the guard. Caswell says his device is absolutely foolproof."

Purifying Used Oil.

There is some conflict of opinion concerning the deterioration of oil from use as a lubricant. In order to determine exactly what degree of deterioration oil suffered from constant use, a series of tests were made on a variety of samples of oil at the Cornell University laboratory. The tests proved conclusively that when oil is properly filtered it can be used indefinitely without losing any of its lubricating qualities.

Filing.

The proper use of a file calls for an order of skill that is only attained through practice and through having some talent for the work. After one has acquired this skill he will need no precautionary instructions as to the care of files, because he will take care of them as the bookworm takes care of his books.

Questions Answered

EXHAUST CLEARANCE.

R. L. C., Ceres, Cal., writes: (1) It appears that Baldwin's 40,000th locomotive, a Pennsylvania Pacific type, has an outside or exhaust clearance of ¼ inch. Is there much advantage in having both ends of the cylinder in communication for such a long period as this would allow? (2) Have cast iron bushings for locomotive side rods ever been tried, and it so are they successful and economical? A.—(1) The Pennsylvania Pacific type locomotive is used in high-speed service, and the valves are given an outside of ¼ inch to permit a free exhaust when running fast with a short cut-off. The effect of this outside clearance is to open the exhaust earlier and close it later. This allows more time for the steam to escape and reduce back-pressure. (2) As far as we know, cast iron is not used for side rod bushings, and we are convinced that it would be quite unsuitable for such a purpose.

SWITCHER TO A MOGUL.

D. C. W., Odanah, Wis., writes: Please answer in your next issue if a 0-6-0 wheeled switcher locomotive could be made into a satisfactory 2-6-0 Mogul for logging purposes without lengthening the frames? A.—This would depend chiefly or the height of the frames above the rail, and the distance between the cylinders and front bumper. It would probably be necessary in most cases to move the bumper forward. This might be accomplished by inserting a suitable filling piece between the frames and bumper. The exact method to be followed would depend upon the design of the locomotive.

WALSCHAERTS VALVE GEAR AND ECCENTRICS.

T. M. Havre, Mont., asks.—(1) Will slightly changing the position of the eccentric crank in the Walschaerts valve gear increase the travel of the valve of one motion and decrease it on the other? (2) How would you figure out how much to lengthen the eccentric crank to increase the travel of the valve ⅝ of an inch? (3) In increasing the amount of inside clearance, should the same amount be taken off both edges of the inside of the valve? (4) In a locomotive where the center line of the cylinder does not correspond with the center line of the axle, how are the keyways for the eccentrics to be marked off in advance? A.—(1) No. It will have the effect of distorting the equable motion of the valve. While the valve would travel the same distance either on the forward or backward motion, the exact point of reversing in relation to the piston would not be the same, with the result that one motion would have too much lead or valve opening, and the other would have no lead, according to how much the eccentric was moved from its true position. (2) Suppose the eccentric described a circle 15 inches in diameter and the valve traveled 5 inches, the ratio would be as 3 is to 1, so would 1⅞ inches be to ⅝ of an inch. (3) The amount of clearance should never be changed unless the constructors have found an error in their work. In case of any change both edges of the inner cavity of the valve should have exactly the same relation to each other and to the steam and exhaust ports as any other part of the valve. (4) No attempt should be made to lay off the keyways for the eccentrics in advance. The eccentrics should be temporarily held in place until the valve gear has been carefully adjusted, when the keyways may be marked off correctly. We presume that you allude to the Stephenson valve gear in this question.

INDICATOR.

H. S., New Orleans, La., writes: Enclosed find a rough drawing of a diagram taken from the left high pressure cylinder of a Mallet engine on the Norfolk & Western. I do not understand how to read such a diagram; that is, if I were asked in an examination what amount of efficiency such a diagram showed, and the particulars in regard to the cut-off, the expansion and the draw-bar pull, I would be at a loss to explain these details. How is it figured out? A.—In the attached diagram there are no dimensions given, and hence we could not give instructions in regard to the particular case, but it may be stated in a general way that an indicator diagram may be taken as an illustration in miniature of the cylinder. This miniature cylinder having the form of a parallelogram should be divided into a certain number of squares, say one square representing each square inch, and if the cylinder should be 28 inches in length by 20 inches in diameter there would be 560 squares in the diagram. It is then no difficult task to compute the number of squares inside or outside of the penciled line on the diagram, the space inside the line being the space where the pressure is effective, and the space outside the line being non-effective.

The cut-off may be readily observed at the point where the pencil mark drops towards the bottom of the diagram. In regard to the draw-bar pull the formula for Mallet compound locomotives is as follows: Square the diameter of the cylinders in inches, multiply by the stroke of the piston in inches, and by the boiler pressure in pounds multiplied by 1.2 and divide this sum by the diameter of the driving wheels. The quotient will be the tractive power in pounds.

It may be added that the complete details in regard to the use of the Indicator are fully discussed in "Twentieth Century Locomotives," by Angus Sinclair.

WEAR AND ENERGY.

W. L. B., Boanavista, Nfld., asks.—(1) With the four bar type crosshead what causes excessive wear on the inside shoes? (2) What is meant by momentum grades? (3) Should an engineer be reprimanded for derailment when this is due to Shay's wheels and foul points, and the speed such as to stop after running one car length? (4) Is kinetic energy and striking force synonymous terms? (5) Where can I purchase books giving details of the air brake? A.—(1) Excessive wear on the inside shoes shows that the guides may not have been lined up correctly, or the crank pin may not be exactly in line with the center of the cylinder, or the main rod may not point straight to the wrist pin. (2) A momentum grade is any grade where the rolling stock once started will continue to move along the track without any force being applied other than the acquired force of momentum which is common to all moving bodies. (3) No. (4) No. Kinetic energy is the energy of a moving body and may be measured by the work which it is capable of performing against a retarding resistance before being brought to rest. Striking force may be measured by the weight of the moving body multiplied by the square of the velocity (5) Books on the air brake can be had from the Angus Sinclair Company, 114 Liberty street, New York.

OIL IN BOILERS.

F. W. Orange, New South Wales, Australia, asks: Can oil at any time get into the boiler from either Nathan or Detroit lubricators through steam valve or boiler that supplies steam to work the lubricator? Would the breaking of a lubricator glass have an effect that might bring about such a condition? A.—No. The oil could not by any condition be forced into the boiler against the steam pressure in either of the lubricators referred to.

SLIP OF THE LINK.

R. W. F., Hoopeston, Ill., asks: Is there any contrivance that will prevent the slip of the link in the Stephenson or Walschaerts valve gear, and what would be the commercial value of such a device? A.—There is no device in use for the purpose of preventing the slip of the link on either the Stephenson or Walschaerts valve gear The value of such a device would depend on its efficiency and its popular adoption. It may be added that the defect known as the slip of the link

is much more pronounced on the Stephenson than on the Walschaerts valve gear, for the reason that the former moves through a larger arc and the tendency to accumulate lost motion is much greater than in the case of the latter.

FIELD CONTROL.

R. L. C., Ceres, Calif., asks: What is meant by "field control" of electric locomotive motors? A.—Field control is not only used in connection with motors mounted on electric locomotives, but on city and interurban trolley cars. An electric motor of the railway type has, as we know, field coils usually four in number, each one of these coils mounted around a pole piece. These coils are connected in series with the armature, and the electric current passes through them. A fundamental characteristic of an electric motor is that the speed of the armature depends on the strength of the field, the latter being governed by the number of turns of wire around each pole piece. For instance, if there was 100 amperes (unit of electric current) being taken by two similar motors, except that the first one had 15 turns per pole and the other one had 10 turns, the second motor would run at something like 1/3 higher speed for the field strength would be weaker. Another fact that enters in is that the motor with the slower speed has more pulling power for the same current, i. e., the 100 amps., than the higher speed motor. Each of these motors is best suited for its own work. The slower speed one for running slowly and pulling heavy loads, the higher speed one for high speed running.

An electric locomotive is called upon to start heavy loads, and then run at high speed, and we at once see that there would be a great advantage if the slower speed motor could be used for starting, and the higher for running. This is accomplished by means of field control adopted to the slower speed motor. Each of the field coils would have a cable connected after the 10th turn. When starting the 15 turns would be used, and then after getting up to speed the last five turns would be cut out, i. e., the electric current would pass through the 10 turns and out at the cable connection.

This arrangement of "field control" is a power saver, as less current is required to do the work than with a locomotive equipped with new field control motors.

BY RAIL AND WATER.

J. S., Trenton, N. J., writes: In reading some account of the electric locomotives that are being constructed for the purpose of hauling ships through the locks of the Panama Canal, I was struck with the apparent smallness of the machinery used in moving very large ships, some of which in the near future may approach 1,000 feet in length. What is the relative strength required in moving loads on rail and on water? A.—The transmission of power necessary in moving loads on rails or by water is about ten to one.

TYPE L SAFETY VALVE.

J. M., Ft. Wayne, Ind., writes: What causes the safety valve of the type L triple valve to pop at a time when there is no pressure in the brake cylinder? I have noticed this just after a light brake pipe reduction has been made before a release. A.—This is caused by a greater friction or resistance to movement between the graduating valve and slide valve of the triple valve than there is between the slide valve and its seat. Under this condition, the light reduction moves the triple valve to service position and when moved to release the slide valve returns the full distance to release the brake cylinder pressure, but the graduating valve, because of the excessive friction, remains partly open and brake pipe pressure from the quick-service port enters the safety valve passage, causing it to pop while the brake cylinder is open to the atmosphere through the triple valve exhaust port. After a heavy reduction this cannot occur because of the differential in pressure between the auxiliary reservoir and brake pipe, as the main piston must be held away from release position for this to occur.

LAP POSITION OF BRAKE VALVE.

J. M., Ft. Wayne, Ind., writes.—With the H-6 brake valve, are all ports in the rotary valve and seat blanked when the handle is in lap position? A.—No. So far as brake operation is concerned, main reservoir, brake pipe and equalizing reservoir pressure are separated, the application cylinder pipe, release pipe and excess pressure operating pipe ports are closed by the rotary valve, but the port leading to the excess pressure pipe is open to admit main reservoir pressure to the upper side of the diaphragm body of the excess pressure governor top.

DISTRIBUTING VALVE DISORDER.

J. M., Ft. Wayne, Ind., writes.—Will a leaky graduating valve in the No. 6 distributing valve cause a blow at the automatic brake valve exhaust port with both brake valves in running position? A.—Yes, if it leaks into the safety valve passage. The duty of the graduating valve is to open and close the service port in the slide valve and connect the application cylinder with the safety valve in all positions except service lap, hence, if the graduating valve leaks, pressure chamber air leaking into the safety valve passage would escape through the emergency exhaust port of the automatic brake valve at the time you mention, but a leak into the service port would flow no further than the equalizing slide valve seat.

TYPE OF EQUIPMENT.

R. L. C., Ceres, Calif., writes: (1) I have noticed that a great many of the valves manufactured by the New York Air Brake Company are quite similar in principle to Westinghouse valves, and at least one triple valve is identical. Have these two companies any agreement relative to manufacturing similar devices without infringing? (2) What constitutes the "Type J" Westinghouse passenger car brake? A.—(1) Yes. These companies have what may be termed a working agreement, the extent of which is known only by the business managers and higher officers. (2) The "Type J" is a New York air brake equipment, consisting principally of the usual triple valve, auxiliary reservoir and brake cylinder, and in addition a supplementary reservoir for high-pressure emergency.

What Is a Mile?

What is a sea mile is a question that is often asked. The distance varies in different parts of the globe. At the Equator, for instance, a knot would be 6,045.95 feet; at the Poles it would be 6,107.76 feet, and in the latitude of the ocean route from Europe to New York about 6,080 feet. Nautical surveyors take into account these small differences, and the measured nautical mile for speed trials on the Clyde, where the Lusitania was built, is longer than the nautical mile used for the same purposes more southerly. The British Admiralty knot is 6,080 feet, and the recognized knot of the United States Navy 6,080.27 feet. A knot in very general use measures 1,000 fathoms, and a fathom being 6 feet, this knot would be 6,000 feet.

The plans of the new Union station at Denver, Col., provide for $300,000 in the remodeling of the present station, $150,000 for the construction of train sheds, $110,000 for interlocking and signal equipment, and over $3,000,000 for the extension of yards and tracks.

The Pacific Light & Power Corporation has approximately $300,000 worth of construction and camp equipment left after the construction of the Big Creek power development. This includes a lot of standard gauge locomotives, dump cars, and other railway equipment, as well as steam shovels, compressors, hoists, trucks, etc.

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Three Cylinder Locomotives.

Nearly all the reports and engineering papers read at the various technical conventions make interesting and instructive reading; but after they are printed in annual reports, most of them are buried to the railroad world as effectually as if they had been destroyed on the day they were read. We were reminded of this fact recently by accidentally finding in the last annual report of the American Railway Master Mechanics' Association the copy of a paper by Mr. J. Snowden Bell on "Three Cylinder Locomotives."

Anything that throws new light upon the details of locomotive development ought to prove interesting and valuable if it is merely to indicate forgotten paths that have already been trodden. The number of inventors who have endeavored to improve the locomotive are legion, and much ingenious labor has been expended on lines of invention that came to nothing, a fact which impresses every engineer on reading Mr. Bell's valuable paper.

Those familiar with early marine engine construction are aware that three cylinder engines came into use among the first successful improvements effected on the motive power used to propel ships, and it was surprising that the same line of invention did so little for the locomotive, for a three cylinder engine produced a smooth rotative action that was conspicuously absent with engines driven single or double cylinders. Before the leading four wheel truck was applied to locomotives the tendency of the two cylinders located outside the frames was to produce a disagreeable lateral motion, which exerted distinctive action upon engine and track. To overcome this defect, as early as 1846 Robert Stephenson and William Howe, of Newcastle, England, invented a three cylinder locomotive, the first of its kind in Europe. From Mr. Bell's description we conclude that the engine was as well designed as might be expected from the most experienced locomotive builders of that day, but it did not prove so far superior to the two cylinder locomotive as to create a demand for its general adoption.

The engine was built for the York, Newcastle & Berwick Railway, and is thus commented on by D. Kinnear Clark in his well known book, "Railway Machinery":

"As the movements of the reciprocating masses acting out of the center line of the machine exactly balance each other, the tendency to sinuous action is removed, and fore and aft action alone remains to be balanced. The engine, accordingly, runs with very superior steadiness, even when unassisted with balance weights in the wheels, and from its peculiar arrangement it is susceptible of a very perfect equilibrium."

Although the patents for the Stephenson-Howe three cylinder locomotives were dated 1846, the engine was not built till several years later; meanwhile the mechanical officials of the Philadelphia, Wilmington & Baltimore Railroad built a three cylinder locomotive, which was mentioned in the Annual Report of the directors for 1847, and evidently antedates the British engine. A second engine of this type was built later, and the Annual Report for 1849 says:

"The cost of the two three-cylinder engines is no greater than that with two cylinders, while they possess on a track most important advantages."

These reports prove beyond a doubt that an American railroad company was the first to introduce three cylinder locomotives, but no information is given of why the type was abandoned after their performance seemed to have been satisfactory. The engines were of the 4-4-0 form, with two outside cylinders, and a single cylinder in the middle connecting with a cranked axle.

The subsequent history of three cylinder locomotives as recorded by Mr. Bell indicates that the most ambitious experiment with three cylinder locomotives was made by Mr. F. W. Webb, chief mechanical engineer of the London & North Western Railway, who between 1893 and 1899 built over 100 three cylinder compound locomotives. These engines were hardly successful under Mr. Webb's immediate supervision, and since his death every one of them has been changed to two cylinder forms. They had two outside cylinders and a single inside.

Various other British and Continental railways tried three cylinder locomotives in half-hearted experimental fashion; but in no case has this form of engine established itself as a recognized class for any company. That the growing demand for heavy power may result in the three cylinder locomotive finding a place in regular train service seems to be probable.

A locomotive designer of acknowledged high standing and ability, discussing the situation with Mr. Bell, said: "We have about reached, especially in some of the large mountain designs, the possibilities of a two cylinder engine." The destructive effect upon the rails, which increases with the speed resultant upon the unbalanced vertical forces in two cylinder engines, has long been recognized, and there being apparently no effective means available for neutralizing this effect, there has resulted the arbitrary limitation of static weight per axle to that which, when augmented by the dynamic effect of the excess balance, will not be above that which can be safely carried by the rails and bridges. This limit varies on different railroads, as effected by the solidity of the road bed, and by local traffic conditions. The tractive power exerted by a locomotive, being dependent upon the weight on driving wheels, and the number of driving axles, each limited in load as above stated, being limited by considerations of main line and yard curvature, it would seem obvious that the most practical and desirable design is that in which the maximum output of power can be exerted with a minimum destructive effect upon the rails."

Information About Shop Tools.

Knowledge is power, a truth which is every day becoming more and more apparent, especially in railway shop operations. The railway companies, which have established schools where apprentices and ambitious workmen are given technical instruction, are all finding that the expense incurred forms the best investment they have ever made.

It is not yet long ago when the men engaged in blacksmith work were regarded as the roughest and most ignorant class of workmen engaged in skilled labor; but in recent years there has been a gratifying change and many blacksmiths talk the science of their business as profoundly as college professors. We have recently been reading some remarks by Mr. Geo. F. Hinkens on the working of steel, which ought to give valuable points to blacksmiths. He said:

Hammering steel increases its density and makes the metal more compact. Take an ordinary steel car axle containing about .45 carbon, subject to as high a heat as it will stand, apply sufficient borax and resin in the same manner as when welding. After it has arrived at the highest welding heat, place under the steam hammer and reduce its diameter about one-half; then return it to the fire and repeat the saturating operation, returning it to the hammer and reducing it to the size of a lathe tool. Let the finishing blows be made at a low, red heat. This process produces a piece of steel that is capable of cutting very hard cast iron, steel or wrought iron. Steel prepared in this manner will not retain its hardness under reheating as the borax-resin, being volatile, escapes when redressing the tool, but for many processes it will prove economical.

Hammering of any kind of cast steel produces similar results, due to the particles being forced closer together by the impact that results from the heavy blows imparted. The coarser the grain of steel the more loose will be its framework, or in other words, a high heat without hammering effects a separation of the mass in one case, while a high heat for hardening will produce the same in the second case. Let us pass hammering and look into the question of heat refining. There is a similar effect in both cases. They will close the grain, as we say, in the shop.

To return to the question of heat refining. Let us take a piece of steel of sufficient length for the purpose, heat it to a light yellow, cool it in water, when cold give it an indentification mark. Take a second piece from bar, heat it precisely as the first piece was heated, lay it down upon dry place and let it cool off. Give it also an identification mark. Then take a third piece from the same bar and heat precisely as the other two pieces were heated. But in the latter case let the heat run down from a light yellow to a cherry red or any other color below the light yellow. Then cool it and mark like the others. After that is done break the pieces for the purpose of finding out if there is any difference in the grain, and no difference will be discovered.

The steel question is one of much importance. The value of a tool cannot be rated by its first cost, nor by the price of the steel, plus the labor, in making the tool. For example, a tap that will thread ten kegs of nuts is much more valuable than one that will thread five kegs. It is its capacity for doing work that determines the value of a tool.

Now, how are we to obtain the most efficient tool? First select the proper steel; second, give it the right treatment at the hands of the toolsmith; third, the proper shape, so that it will cut with the least resistance, and accomplish the maximum amount of work in the minimum amount of time.

Reduction of Freight Rates in Canada.

While the railroads of the United States are wrestling with the Interstate Commerce Commission to obtain an increase in freight rates, the information reaches us that the Railway Commission of Canada has ordered a substantial reduction in freight rates. We are sorry to note this action, for experience has proved that it is much easier to reduce freight rates than it is to restore them to a paying basis.

All Canada west of the Great Lakes is divided into three zones. The first of them extends from the lakes to the mountains and is to be known as the Prairie Section. The Pacific Section includes British Columbia, while the zone to be known as British Columbia Lakes Section applies to the navigable waters in that province.

For each of these three sections a standard of maximum freight rates has been set. What is at present known as the Manitoba standard has been extended to fix all rates in the Prairie and British Columbia Lakes Sections, abolishing the higher rates now charged in Saskatchewan and Alberta. While the Pacific Section rates will be somewhat higher than those of the Prairie and British Columbia Lakes Sections, they will nevertheless be lower than the maximum now in force in Saskatchewan, Alberta and British Columbia, the provinces included in this section.

Better Than Coal.

Fuel oil consists essentially of carbon and hydrogen, and the proportion of the latter is high enough to add materially to its heating power. It contains little or no oxygen to reduce the heat units obtainable from it, and, as appears from the figures quoted, it gives out much more heat, weight for weight, during its combustion than coal. Fuel oil also owes part of its superiority over coal in heating power to its greater freedom from moisture, ash, and other agents. It is sufficiently accurate to regard the reducing effect of mineral matter, moisture, etc., on the heating power of coal as due to displacement of combustible matter. A coal containing 5 per cent. of ash and 5 per cent. of moisture would, so far as these constituents are concerned, contain only 9 lbs. of combustible matter in each 10 lbs. of coal. The ash and mineral matter in coals vary greatly. The moisture may rise to 10 per cent. and over, and ashes of 40 per cent. and over have been recorded. Fortunately these are excessive figures, and the proportions often run below 5 per cent. When the ash and moisture are low (and in some coals they may be as low as between 2 and 3 per cent.) the higher values for the heating power are possible. Fuel oil, however, is readily obtained free in a high degree from these constituents. The United States Government refuses consignments containing more than 2 per cent. of moisture, and insists on its being practically free from mineral matter. The higher proportions of carbon and hydrogen in fuel oil, and the practical absence of substances exerting a depressing effect on the heating power, explain the greater number of heat units obtained during the combustion of oil.

The New Haven Electrification.

For several months past large forces of men have been at work electrifying the main line of the New York, New Haven and Hartford Railroad between Stamford and New Haven.

So far as engineering and construction experience can indicate, the overhead contact and distribution system between New York and New Haven, it is believed, will be completed by June 1. Electric freight, passenger and switching service can then be established between New York and New Haven.

The original electrification of the New Haven road between Stamford and Woodlawn, begun in 1905 and completed in 1907, embraced 21½ miles of route and 110 miles of single track. As the New York Central had the year previous electrified its track from the Grand Central station to Woodlawn, where the junction with the New Haven tracks is made, a distance of 12 miles, this made the total route distance for the New Haven's original electric service between the Grand Central station and Stamford one of 33 miles.

After considerable experience with the electric service, the six track Harlem river branch was electrified and then work began on the line east of Stamford.

The power house was enlarged, but at present it will not be large enough to handle 100 per cent. of the traffic at New Haven and New York.

Nothing Against the Delaware & Hudson.

In the March number of RAILWAY AND LOCOMOTIVE ENGINEERING an article headed Blind Punishment seems to reflect unfairly upon the Delaware & Hudson Railroad. In the beginning of the article some comment was made on the Delaware & Hudson strike which could hardly be regarded as being unfair and then we took up the complaint of a correspondent belonging to another railroad who had been cruelly punished for permitting the water of an engine he was running to become so low that damage to the crown sheet resulted. In our opinion there was no proof of low water sufficient to inflict severe punishment and we said so, but it had no reference whatever to the Delaware & Hudson and we are sorry that it has been so construed.

Tests of Car Couplers.

A series of tests is being conducted by the University of Illinois for the Scullin-Gallagher Iron & Steel Company, of St. Louis, on a new style of car coupler which is believed to be an improvement over the coupler now in use.

The weak point of most car couplers now in use is the face, this being the place where fracture generally occurs. The new style of coupler eliminates this difficulty by having a solid face and a new type of tail knuckle. A former test made by the university, showed that when failure of the new style coupler occurred, it was generally at the knuckle. After the first tests, the design was changed so as to add about 15 lbs. of metal to the knuckle. The new design is now being tested under the supervision of Prof. J. M. Snodgrass, of the Railway Engineering Department.

Four sets of tests are made: The "striking test," the "jerk test," the "guard-arm test," and the "pulling test." In the striking test the coupler is placed in the drop testing machine and a 1,640-lb. weight let fall on it from varying heights.

The first series of tests was witnessed by Mr. Logie, vice-president of the Sampson Car Coupler Company; Mr. Morey, mechanical engineer of the company, and Mr. H. E. Doerr, mechanical engineer of the Scullin-Gallagher Iron & Steel Company.

Government Officials Stirring Up Smoke Abatement.

In spite of all that has been said, done and written about smoke prevention, there seems to be very little abatement of the black smoke pouring out from the chimneys of nearly every manufacturing concern in the country. In such cities as New York, where smoke prevention ordinances are strongly enforced, smoke is prevented by using smokeless fuel, but in nearly every other place where furnaces are in operation the smoke seems to be as much in evidence as it was 30 years ago, when smoke preventing formulas had not been so glibly interpreted as they are today.

Meanwhile it is gratifying to observe that the United States Government has not given up hope that a remedy for it cannot be worked out. This is not entirely a new movement on the part of government officials. It only appears that every new batch of government scientists take a new hitch on the smoke prevention problem, and pull upon it altogether for a few years, then give up the effort for their successors to grapple with.

Blame is put upon the owners of plants where hand firing is done for being the most persistent smoke raisers, and automatic stokers are recommended as a sure remedy. Much depends upon the man operating such a stoker, but he has received . credit from the government officials.

The greatest improvement made in smoke prevention has been effected by the men firing locomotives. Smoke is still in evidence from that source, but it is not one-tenth so great as it was ten years ago. This fact is apparent to every person whose memory carries him back to the conditions that existed in the days when firemen operated to keep a black stream continually flowing from the stack.

Dissolution of United States Express Company.

The directors of the United States Express Company have decided to dissolve the company because its operation no longer pays. This act will throw 15,000 persons out of employment, many of whom have spent a long working life working for the company. The employment was apparently permanent and the salaries low, but the men adhered to their jobs with little opportunity of making provision for old age and now that the end has come unexpectedly much suffering will result.

When news of this financial disaster was made public assertions were made that the competition of the Parcels Post had brought the United States Express Company to the condition that compelled liquidation, but the truth of that was denied by Duncan I. Roberts, president of the company. He asserted that new rates fixed by the Interstate Commerce Commission was the chief cause of the closing down of the United States Express Company, but that the low rates imposed by state railroad commissions had helped to make the expense of operating greater than the income.

There is something strange about the attitude of bodies elected or appointed to supervise transportation. The aim of the people in having interstate or state railroad commissions appointed has been to see that justice was done between shippers and transportation concerns, but these commissions have nearly always deemed it their duty to persecute the transportation companies. The men appointed have nearly always been selected by politicians and they have acted on the principle that it is good to hit the head of the government.

The Fuel Consuming Locomotive Boiler.

The boiler used to generate the volume of steam passed through the cylinders of a large locomotive has to perform a higher steam making service than any other boiler in use. To obtain from the average locomotive, said Mr. D. F. Crawford, the average power required, it is necessary to consume fuel at the rate of about 100 pounds of coal per square foot of grate per hour, and to obtain a maximum power required it is necessary to consume 150 lbs., and at times in excess of this amount, per square foot of grate per hour. That is, to obtain the power necessary to perform the work demanded, a boiler which from its heating surface would be rated at about 320 H. P. is frequently forced to develop over 1,500 boiler H. P., and our records show that another boiler which would on the basis of heating surface be rated at about 400 H. P. has developed as high as 1,994 boiler H. P. The performance stated above requires coal consumption at the rate of from 6,000 to 10,000 lbs. of coal per hour, and this has been done on a grate of 55 sq. feet."

The design of the locomotive boiler is well known and has not changed materially from that of our forefathers, save in size and capacity. True, the firebox has risen up from between the frames and spread out over them, and in most cases now, beyond the wheels also. Flues have been lengthened and shells enlarged in diameter, so that flue heating surface could keep pace with grate area, as well as to provide the room and proper loading of the wheels, which have also multiplied. Not content with one double engine under the boiler, the Mallet type uses two, and we now hear of a new development of using a third engine under the tender and utilizing its weight to secure additional tractive effort.

The enormous amount of coal consumed by some locomotives justifies the efforts being made to reduce the toil of firemen by introducing mechanical stokers. An able-bodied man shoving coal out of cars is reputed to be doing fair work when he moves one ton or 2,000 pounds per hour, but advance practice requires a fireman to handle four or five times the quantity handled by the laborer and that task has been successfully done in some instances.

Suit Against the Lackawanna Dismissed.

Among the concerns that the Department of Justice of the United States has been prosecuting for alleged monopoly has been the Delaware, Lackawanna & Western Railroad Company for alleged monopoly. A suit was brought against both the railroad company and the Delaware, Lackawanna & Western Coal Company, for violation of the Sherman Anti-Trust Law and the commodities clause of the Hepburn Act, which prohibits a railroad company from transporting and selling products in which it is interested. The case was brought before the United States District Court and dismissed.

The action was instituted against the Lackawanna and its allied coal company in February, 1913, and was argued in Philadelphia under an expediting certificate on January 27, last. It aroused unusual attention from the fact that it was the forerunner of similar suits against other railroads having coal interests, and because it was regarded by the Washington authorities as a critical test of the efficacy of existing statutes to carry out a programme of reforms favored by President Wilson.

Recalescence.

The writer has been so long in the habit of visiting railway machine shops, and talking with all lines of workmen, that he very rarely hears a new expression; but this novelty came to him lately by a tool dresser using the word "recalescence." After a long search we find that Mr. George F. Hinkens, a well known writer on blacksmithing, says: "The point of recalescence is that temperature varying for each carbon percentage at which cooling pauses awhile, gets hotter of itself, and again goes on cooling. When the steel gets hotter of itself, it is at the refining point, or the point of recalescence, and at the right stage for cooling."

Another authority says: "The point of recalescence is indicated by prominent waves playing over the bar. When the wave disappears it passes from the center of the bar, which is an indication that the refining is completed, and the temperature of the bar is uniform throughout, and if quenched under those conditions will produce ideal steel in the hardened state."

Who will say after reading these statements that our workmen are not versed in the science of their business?

Machine Made Figures.

In the financial department of the Canadian Pacific Railroad, representing something like $100,000,000 per annum—that is in the value represented by the papers it handles—that the adding and tabulating machines get in their fine work. These machines are manipulated, in some cases, by little girls, who have long since got over the wonder of them. Marvelous they are, however; they disclose a superhuman intelligence. They reach the conclusion before the manipulator has got his thoughts together, they anticipate the cerebration of the human mind.

The tabulating machines, operated by electricity, are positively uncanny. They are diabolically subtle. The conclusions they reach are appallingly and implacably accurate. They work out the higher mathematics by pressing a button. They tackle and solve the most amazing arithmetical problems without ever turning a hair. They give you the number before you have well stated the proposition. They anticipate the sluggish mind. They are greater than their inventor. They are fearsomely intelligent. They exert a species of necromancy that baffles the human mind. But they are, of course, prodigious labor savers. They do work like lightning which had at one time to be done laboriously and faultily by hand. They do the work of dozens of men.

Diesel Engines for Ship Propulsion.

Information comes from Glasgow, Scotland, that an influential British money syndicate has been formed in California for the purpose of building ships for the American coasting trade, to be equipped with Diesel engines. This is one of the first moves to utilize the Panama Canal.

The case was cited of the Danish motor vessel Siam, which loaded 1,000 tons of oil at San Pedro for a European port, and made the run on a fuel consumption of 10 tons of oil per day, as compared with from 55 to 60 tons of coal for a steam driven vessel of the same capacity. The value of 10 tons of oil at San Francisco was about $65, as compared with $420 for 60 tons of coal, and the net saving in fuel alone was thus $355 per day—with the heaviest oil produced in California. On the homeward run the Siam would save nearly $20,000. But the gain in freight space was about 17 per cent., while the stoke-hold crew of 20 men were entirely eliminated.

Referring to this subject, Mr. A. L. Weil, of the General Petroleum Company, said that the operation of such motor vessels on the Pacific coast would extend the radius of California commerce to the ultimate verge of the habitable world. He felt every confidence that this would result in eliminating the existing surplus of the heavier oils, for a character of oil which could not be consumed at all in an automobile was the best for the Diesel marine motors.

The new British syndicate will control 100,000 barrels of California fuel oil daily out of 270,000 barrels produced per day in the whole of the State. This will be brought about by the absorption of the General Petroleum Company of California, and the Union Oil Company, of the same State, at an expenditure of at least $30,000,000.

Charcoal.

Charcoal in different phases performs important functions in domestic and industrial economy, yet the material possesses characteristics that are unknown to the world in general. In the long ago the most useful purpose to which charcoal was applied was in the reduction of iron ore to the condition of pig iron. In the forges of ancient metallurgists charcoal was employed to convert rich iron ores directly into steel, what was known as the Wootz process having been carried on in this manner.

Charcoal pig iron was made extensively in Scotland at one time, and formed the beginning of the great iron and steel works, for which the country afterwards became famous. The exhaustion of the forests greatly curtailed the making of charcoal iron, and only one furnace now continues in operation, situated at Backbarrow on the river Leven. This furnace was erected in the early part of the 18th century, and has been little changed since the time it was erected. The iron produced is the most expensive iron sold, and most of it is used in the United States in the process of making malleable iron castings.

Carbon results from the destructive distillation of wood and animal matter. The composition of charcoal depends upon the temperature at which it is produced. At high temperatures all the oxygen and hydrogen of the materials are expelled, and a black substance remains. It burns without flame or smoke, and produces an intense heat. It is infusible, is not soluble in acids or other liquids, is not liable to decay, and is not changed by any degree of heat if it be not exposed to any source of oxygen. Carbon has many other useful properties.

Railway Signal Engineers.

The United States Civil Service Commission announces an open competitive examination for junior railway signal engineers on May 20, 1914. Applicants must show in their applications that they have had at least three years' practical experience in railway signal work. Experience with railway signal companies will be considered as qualifying. Persons who meet the requirements, and desire the examination, should at once apply for application Form 2039, to the U. S. Civil Service Commission, Washington, D. C.

Mallet, 0-8-8-0 Type Locomotive for the Lake Shore

Gravity or hump yard switching is constantly increasing in large and busy yards. At present there are 95 gravity switching yards on 30 different systems. These yards represent an investment of many millions. Therefore as the road engine increases in size it becomes relatively important to provide means at these yards whereby the heavy trains may be economically handled.

When big road engines bring in their large trains it generally becomes necessary to divide the train before classification. This means more operating units and more congestion. The average yard conditions as they exist today will not permit a long, rigid wheel base. This is a severe limitation to the simple engine, and restricts the design as to size and power. Mallet engines, with their drivers arranged in two independent sets, readily meet these limitations, and also permit the designing of a locomotive powerful enough to handle the road train in one unit.

After carefully studying their conditions the officials of the Lake Shore & Michigan Southern Railway placed an order with the American Locomotive Company for three Mallet engines for hump service. Two of these engines are now in hump service at Elkhart, and one at Air Line Junction. Mr. A. R. Ayers, General Mechanical Engineer, advises as follows: "We find that these engines will handle the same trains that the G-5 and G-6 engines bring into the yard. It was necessary to divide these trains in order to handle same with former power; this work was previously done by class M engines." Class G-5 and G-6 are heavy Consolidations. Class M is a ten-wheel switcher.

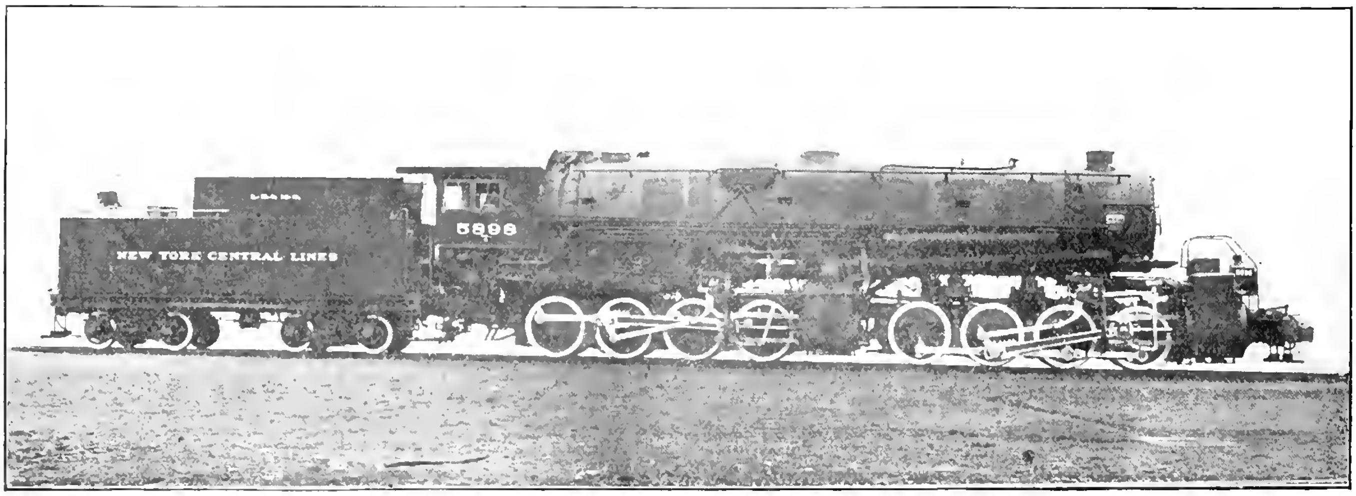
A comparison of some of the principal dimensions with the ten-wheel switchers supplanted shows some of the advantages of the Mallet for this particular service. The ten-wheel switchers have a rigid wheel base of 19 ft. 0 ins., the Mallets, 14 ft. 9 ins. Because of the many cross-overs, this short rigid wheel base should be very desirable. The Mallet, with its tender, weighs 622,500 lbs. The ten-wheel switcher, with its tender, weighs 424,000 lbs. The Mallet has a tractive power of 100,500 lbs. working compound, and 120,600 working simple. The ten-wheel switcher has a tractive power of 55,400 lbs. With only 47 per cent. increase in weight, the Mallet has 81½ per cent. greater tractive power working compound, and 117½ per cent. greater tractive power working simple.

The boiler warrants special attention. It is a conical connected type, and is 88 ins. in diameter at the front end, and 100 ins. in diameter at the largest course. The barrel is fitted with 255 tubes 2¼ ins. in diameter, and 45 flues 5½ ins. in diameter and 23 ft. long. The firebox is 150⅛ ins. long by 94¼ ins. wide, having a grate 121⅛ ins. long. A Gaines combustion chamber, combined with a Security brick arch, and the railway company's arrangement of combustion flues are also included. This firebox has a heating surface of 311 sq. ft., with a grate area of only 81 sq. ft.

A novel feature is the arrangement for operation from either side. This was necessitated by the possibility of the engine being headed either way. A specially designed bracket, one on each side of the engine backhead, holds the operating levers for the throttle and power reverse gear. Both throttle levers are clamped to a hollow shaft, which extends across the backhead, and operates the throttle by a series of cranks. The throttle lever on the right hand side has a latch which locks on a quadrant. This latch is linked with the latch release handle, which in turn is linked to the main handle and a crank. This crank is keyed to a solid shaft which passes through the main hollow operating shaft, and is cranked and linked to the latch release handle on the left hand side. Thus either handle locks, unlocks and operates the throttle. A similar method is used in connecting the power reverse levers. Each side also has main and straight air brake valves with their gauges.

The Street stoker, radial buffer, Ragonnet reverse gear and a pyrometer were also applied

Additional strength with no increase in weight was secured through an extensive use of vanadium. The parts constructed of this material include engines, frames, driving axles, main and side rods, rod straps, eccentric cranks, driving springs, tender elliptic springs and crosshead keys. Cylinder castings were constructed of cast iron with vanadium content.



MALLET TYPE LOCOMOTIVE FOR THE LAKE SHORE & MICHIGAN SOUTHERN RAILWAY

D. R. McBain, Superintendent of Motive Power. American Locomotive Company, Builders.

The following are the general dimensions of this type of locomotive:

Track gauge, 4 ft. 8½ ins.; fuel, bitum. coal.

Cylinder, type, h. p. piston, 16 ins.; l. p. slide, diam., 40 ins.; stroke, 28 ins.

Tractive power, simple, 126,960; compound, 105,800.

Factor of adhesion, simple, 3.65; compound, 4.37.

Wheel base driving, 14 ft. 9 ins., 14 ft. 9 ins.; rigid, 14 ft. 9 ins., 14 ft. 9 ins.; total, 40 ft. 3½ ins.; total, engine and tender, 74 ft. 4¼ ins.

Weight in working order, 466,000 lbs.; on drivers, 466,000 lbs.; engine and tender, 622,500 lbs.

Boiler, type, conical conn. O. D. first ring, 88⅛ ins.; working pressure, 220 lbs.

Firebox, type, wide; length, 150⅛ ins., width 96¼ ins.; combustion chamber, length, 30 ins.; thickness of crown, ⅜

in., tube 9/16 in., sides 3/8 in., back 3/8 in.; water space front, 4½ ins., sides 4½ ins., back 4½ ins.; depth (top of grate to center of lowest tube), 17⅝ ins.

Crown staying, radial

Tubes, material—charcoal, iron; number 255; diam., 2¼ ins.

Flues, material—seamless steel; number 45; diam., 5½ ins.

Thickness tubes, No. 11 B. W. G.; flues, No. 9 B. W. G.

Tube, length, 23 ft. 0 in.; spacing, ⅞ in.

Heating surface, tubes and flues, 4,924 sq. ft.; firebox, 311 sq. ft.; arch tubes, 54 sq. ft.; total, 5,289 sq. ft.

Grate, style—rocking.

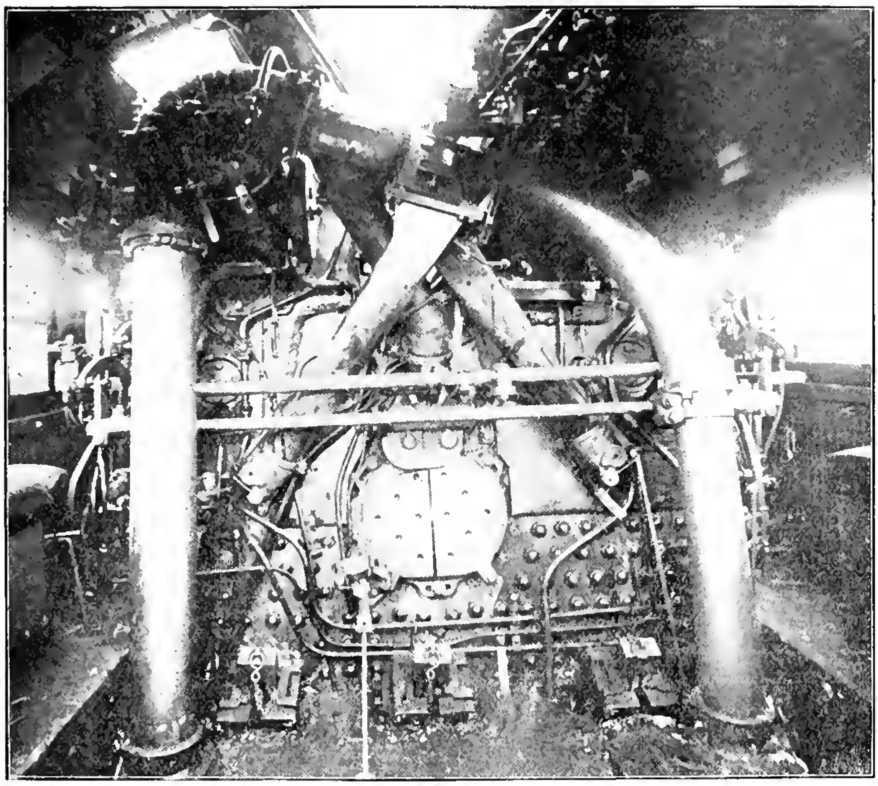
Piston, rod diam., 4 ins.; piston packing, gun iron ring.

Smoke stack, diam., 20 ins.; top above rail, 14 ft. 11/16 ins.

Tender frame, cast steel.

Tank, style—water bottom; capacity, 8,000 gallons; capacity fuel, 14 tons; H. P. piston.

Valves, type, L. P. Allen; travel, H. P. 6 ins., L. P. 6 ins.; steam lap, H. & L. P. 15/16 in.; Richardson slide; ex. cl. H. P. ¼ in., L. P. 7/16 in.; setting, lead, H. P. ⅛ in. max. cutoff, 88.2 per cent.; L. P. 3/16 in. max. cutoff, 87.5 per cent.



VIEW IN CAB OF MALLET TYPE OF LOCOMOTIVE WITH STREET STOKER.

Superheater surface, 1,235 sq. ft.

Grate area, 81 sq. ft.

Wheels, driving diam. outside tire, 51 ins.; center diam., 44 ins.

Wheels, driving material—main, cast steel; others, c. steel; tender truck diam., 33 ins.; forged steel.

Axles, driv. journals, main, 10½ x 14 ins.; other, 10 x 14 ins.; tender truck journals, 5½ x 10 ins.

Boxes, driving—main, c. steel; others, c. steel.

Brake, driver—Amer. W. Z. 3; West. E. T. 6; tender, West. E. T. 6; pump, 8½ ins. C. C.; reservoir, 1—16 x 138 ins., 1—16 x 84 ins., 1—20½ x 66 ins.

Exhaust pipe, combination, nozzles 6, 6¼, 6½.

Instructions to Embryo Engineers.

In a recent issue of the *Electric Journal* there is a letter written by W. V. Turner, chief engineer of the Westinghouse Air Brake Co., to a young man contemplating an entry into the engineering profession. It contains some advice particularly valuable to any young man starting out on any career in the business world, as it contains a great deal of advice that cannot be found in the text books of the school room and is not generally recognized by the teachers. The letter of about 6,000 words, appears in the November issue of the *Electric Journal*, and we regret that it cannot be printed verbatim in these columns, as the extracts we do wish to print are rather difficult to obtain in a manner that will retain the original meaning; however, we will attempt to give our readers a general idea of the trend of the author's desires.

Mr. Turner would first impress upon the young man that loyalty to the company is the first consideration, and second the discovery and fulfillment of duties whether disagreeable or otherwise, then dwells upon the necessity for courtesy and tact, a pleasant demeanor, integrity both in fact and purpose, and accuracy.

The following is quoted from portions of the letter:

"Cultivate intuitive reasoning, that is, if your conclusions do not conform to common sense and physical law, obviously, in case of doubt, a review of the whole question is incumbent upon you. For example, if your solution of a problem demonstrated that you would get something for nothing, you would know prima facie that there was an error somewhere as this is contrary to nature and would involve a miracle.

"Obey orders. Be a good soldier. The reason for orders or instructions may not, in fact will not, always be clear to you and, therefore, you may be apt to look upon them as unreasonable or even foolish, but remember as compared with your superiors, you see 'through a glass darkly,' these instructions may be and probably are, only links in a very long chain and that policies are much broader and cover a scope inconceivable to you at the moment. As you travel up the hill side the horizon will widen out and many things will appear that were hidden while you were in the valley. In many cases the good and wise policies of a concern have been defeated of their full attainment for lack of full-hearted obedience and co-operation by those who constitute it.

"Co-operation is a duty you owe both to yourself and to your fellows. Self-seeking generally defeats its purpose, for few can go it alone, and he who refuses to help others will generally be forced to do this, as only he who gives shall receive. Not that you are sure to receive if you give, but you are very likely to, while if you give not you are sure not to receive.

"You must expect to meet all that is good and all that is bad in human nature, particularly if you forge ahead, for it is only then that you are worth while as a mark, for adulation or for envy. It is here that you will meet your supreme test, you may be lulled to sleep by one or rattled to destruction by the other.

"Cultivate a cheerful acceptance of the disagreeable, annoying, irritating and difficult actions and circumstances necessarily attendant upon any position in life.

"I desire to call your attention particularly to the difference between accumulated knowledge and the application thereof. Do not think because you have attained to a large degree of technical knowledge that you have learned how it should be applied to the practical details

of a life's work, or that theory can take the place of practical experience or that it is evidence of a 'level head.' . . . It is not he who knows the most but the man who can meet the conditions best who is the best engineer, in other words, it is in the application of knowledge and common sense that the great results lie and from which successful achievement results.

"Avoid debt as you would a pestilence. By debt, I mean assuming obligations beyond your means, or that you cannot with reasonable certainty expect to repay.

"Save some money from every dollar you earn, because such a policy makes for independence of action, it makes for power and influence. . . . There is a practical contentment and moral courage in a bank account that a man can acquire in no other way. At the same time do not forget that generosity and charity are virtues. Therefore be generous and charitable to all whose wants and conditions make you to some extent their servant or keeper. This will at times call for sacrifice on your part, but to be a whole man you must not shirk it.

"Do not forget in thinking of your duty and responsibility to others that God holds you responsible for yourself and expects developments in you at least equal to that you would insure in others.

"Do not be too ready to endorse or condemn anything from the mere abstract supposition that it is either right or wrong, for this is largely a question of custom, environment, and the opinion of a number formulated into a law, and is different in different places and at different times. . . . Do not condemn until you are reasonably sure you have a substitute that will change things for the better, then proceed, not to compel, but to educate others into the adoption of a more progressive course.

"Do not be discouraged because others do not rush with embracing arms to accept your convictions, for, even though you may be right it may be necessary for them to climb the same paths to the mountain top before they reach your conclusion, and you will find that they can be induced to climb the path where they cannot be compelled. Discouragement in the demeanor of one who would lead is a decided handicap, and . . .

"Avoid excess of every kind, for there is no avoiding the promise to pay. Involved in any transaction pertaining to your physical or mental nature, is a debt which may not be collectable on a sight draft, but never forget that a deferred payment inevitably matures and when the demand is made, payment can neither be evaded nor postponed. Whenever fatigued, rest in some form should be welcomed, but do not mistake laziness for fatigue. Remember that every man is as lazy as he dares to be."

Mr. Turner then urges a study and analysis of human nature and calls attention to the necessity of making distinctions between matters that are important and unimportant to the purpose in life, and advocates the learning of the principles of logic which he terms the art and science of reasoning, giving concrete examples of the applications of the terms "why" and "what of it" to a problem in an engineering sense.

Concluding this, Mr. Turner states, "While the foregoing may seem to inculcate upon you those things which make for what we call 'material success,' they go much farther, for one could hardly succeed by the exercise of the qualities I have laid down without also attaining that success which is more than personal—a success that will give you power and influence which will be used for the well-being and betterment of mankind—a success that when you come down to the River will enable you to look back and feel the assurance of a life that fundamentally has been lived for the best."

Will Use Oil for Fuel.

An inspection trip has been made by the chief engineer of the Canadian Pacific railway to Vancouver and Victoria for the purpose of investigating the cost and feasibility of using oil in the locomotives on the Cascade subdivision of the British Columbia division, both in passenger and yard engines. Oil tanks will be established at Vancouver, Coquitlam, Mission Junction and North Bend to supply the fuel for the locomotives. The work of converting will be done at the local shops. Oil has been used for fuel purposes for some time on the sections between Kamloops and Field, and it is planned to extend the system to the other portions of the road. Engines on some of the branch lines of the Province have also been using oil for fuel. After the engines on the Cascade division have been changed and placed in commission it is intended to extend the plan to the section between North Bend and Kamloops, completing the change on the entire British Columbia division.

Murderous Automobiles.

It used to be that railway companies were held up by the public prints as awful examples in the reckless manner they sacrificed human life. The persistent cultivation of the idea, "Safety first," among railway people is doing much to reduce fatal accidents in train service, but a new source of life destruction has invaded our highways and streets in the form of automobiles. When used rationally an automobile is a source of real pleasure, and frequently a great convenience, but most of the people who handle such machines are carried away with a craze for high speed. Indulging in excessive speed is the cause of the numerous fatal accidents that are making automobiles a curse to the people.

The fatalities vary greatly in different cities, due no doubt to the manner in which speed is regulated and the laws concerning the same enforced. New York City is probably the worst ruled city in the world, as the number of people killed by recklessly driven vehicles is terrible. During the year 1913, 64 people out of every million of the population lost their lives by being struck by automobiles in the streets; yet that slaughter of human beings has not excited any indignation among the survivors.

Railroads in Armenia.

During the past year there were rumors of the granting of numerous concessions to French and Russian firms for building railroads from the Black Sea coast to different points in the interior. Work has already been started on a line from Samsun, on the Black Sea, to Sivas, an interior city north of Harput. It is reported that work is progressing rapidly on the Constantinople-Bagdad road, and that it now extends from Aleppo southward to a point near Urfa, within some six days of Harput. This interior country is gradually waking up, and if railroad accommodations are ever installed a prosperous era is insured.

Railway in Iceland.

Plans are completed for the construction of the first railway in Iceland. It will be a narrow gauge line running from Reykjavik through the Thingvalla district—the most fertile part of the island—to Rangavalle, a distance of about 64 miles, with a branch line to the port of Eyrarbakki, an additional 12 miles. Although the track will run through hilly country, the boring of tunnels will be avoided; but a great many bridges are necessary to carry the line across numerous streams. These bridges have to be of especially solid construction, owing to the floods which come down in raging torrents from the mountain sides in the brief Icelandic summer.

New Ocean Tunnel.

The governments of Sweden and Denmark have had plans made for the construction of a tunnel under the sea channel that separates the two countries to accommodate a railway that will establish direct communication between Stockholm and Copenhagen. The submarine tunnel will be about nine miles. Some thirty miles of railway will have to be built in connection with the tunnel. It is estimated that railway and tunnel will cost about $25,000,000.

Elements of Physical Science

By JAMES KENNEDY

IX. GRAVITY.

The tendency of bodies when unsupported is to fall to the ground. This is called gravity, and this law of attraction is universal. It is not confined to the surface of the earth alone, but extends through space and, as has been already stated, is the agent by which the stars are kept in their spheres. This law of gravitation is a constant principle and acts instantly, and is not lessened by the interposition of any other substance, and is also entirely independent of the nature of matter. It has been scientifically demonstrated that the action of the sun is found to be the same on all of the heavenly bodies. It is the force of attraction or gravitation that keeps all movable bodies on the surface of the earth from falling into space.

It may be noted that the force of gravity increases as the amount of matter increases, and the force of gravity decreases as the square of the distance increases. In regard to the planetary system of which the earth forms a part, the sun is 800 times greater than all the planets put together. It is on this account that its attraction is felt by the remotest bodies of the solar system. Weight of bodies is simply a measure of the force with which bodies are drawn toward the earth, and if the earth contained twice the amount of matter that it now contains all bodies movable upon its surface would be found to have twice their present weight. As gravity decreases as the square of the distance from the earth's center increases, it follows that bodies become lighter in proportion to the distance that they are removed from the earth's surface. A mass of iron weighing one ton on the earth's surface would be found to weigh only a quarter of a ton at a distance of 4,000 miles. The varying weight on the earth's surface is small. At four miles above the surface of the earth a body weighing 1,000 pounds becomes only two pounds lighter.

X. FALLING BODIES.

All bodies acted on solely by gravity fall to the earth with the same velocity. It is true that a metal ball will fall faster than a feather, but this is not owing to a variation in the fixed law of gravitation, but arises from the effect of the atmosphere hindering the flight of the lighter body. The descent of a parachute is a good illustration of this interference of the atmosphere with the gravitation of expanded bodies. The effect of the expansibility of bodies on falling can be exactly determined, and, taking the parachute as an illustration, it will be found that in order to deter the falling of an ordinary man to a speed of safety, the parachute would require to be about 22 feet in diameter.

Falling bodies have an accelerating velocity, or, in other words, gravity gives a falling body a certain velocity in the first second of its descent. This is increased in the next second, and so on till the falling body reaches the earth. There are several methods whereby the velocity of falling bodies may be readily determined, the simplest being that formulated by experiments with Atwood's machine, a contrivance whereby two small weights are balanced over running pulleys and a slight addition being made to one of the weights the pulleys are set in motion, and are so arranged that the heavier of the two weights is 64 times as long in descending a measured distance as it would be if dropped freely in the air.

It is found with this machine that if the distance through which a body falls may be reckoned as one during the first second of time, that traversed in the second will be equal to three; that in the third will be equal to five; that in the fourth, equal to seven, and so in the continuing series of odd numbers. Repeated experiments have demonstrated that solid bodies of matter falling to the surface of the earth have a velocity of a little more than 16 feet during the first second; in the next second the body will pass through 48 feet of space; in the third second the distance traversed will be 80 feet, and so in an increasing ratio till the surface of the earth is reached.

From this formula the velocity of falling bodies at any particular part of their flight can be determined, or the total distance traversed can be obtained; thus to find the velocity of a falling body at the termination of any second of its descent all that is necessary is to arrange a series of odd numbers, these being 1, 3, 5, 7, 9, 11, and so on, and supposing that we desire to ascertain the distance traversed during the fifth second. The fifth figure of the series being 9, we multiply that by 16, which gives 144, being the distance in feet. Again, if we desire to ascertain how far the weight has traveled during 5 seconds, we multiply 16 by the square of the given number of seconds; squaring 5 gives 25, which multiplied by 16 gives 400, the distance in feet which the body has passed through in 5 seconds. These rules apply to bodies acted upon by gravity alone. A body thrown downward with force equal to 50 feet per second will retain this velocity, in addition to the gradually increasing velocity acquired from gravity.

In this connection it should be remembered that the density of the falling body, and the atmospheric resistance slightly affect the velocity. Experiments at the Washington Monument and at St. Paul's Cathedral, London, show a slight variation from Atwood's formula. At the former place a ball dropped from a height of 555 feet took a little over six seconds in falling to the ground; whereas the calculations give 576 feet as the distance traversed by falling bodies in 6 seconds.

XI. ASCENDING BODIES.

Falling bodies, as has been stated, increase their velocity 32 feet per second; so ascending bodies, being acted upon by the same force, lose a like amount until they are brought to rest. If the initial velocity is known and divided by 32, we find the number of seconds in which the body will continue in its upward flight. On this principle a bullet shot vertically upward should descend at the same velocity and with the same force as it had when originally discharged. The resistance of the air, however, lessens its force considerably, just as a projectile thrown through the air is borne some distance in a straight line, but as its velocity diminishes the force of gravity which impels it toward the earth, and the resistance of the air which tends to bring it to rest, causes the projectile to move in a curved line, known as a parabola.

Chinese Railways.

The Nankin-Huan Railway is to be completed, thus covering the south bank of the Yangtse with a British network. It is felt that the Franco-Belgian Trans-China Railway should adhere to the first alignment, debouching, as originally agreed, at Hai Chow, 200 miles north of Shanghai, and at all costs not at Hai-Mon-Ting, on the Yangtse estuary. It is also considered that an option should be demanded for the long-planned light railway from Burmah, namely, the Bhamo-Moulmein-Talifu alignment, thus guaranteeing overland entry from British territory into Szechuan.

Parsons Steam-Turbines.

The number of British vessels with geared turbines—war and mercantile—built and under construction, is 89, with a total horsepower of 634,000. Some of the installations in the war vessels are only part-geared, but only the power developed by the geared turbines is included in the above. In all cases we understand the geared turbines are working most satisfactorily.

Catechism of Railroad Operation

NEW SERIES.

Second Year's Examination.

(*Continued from page 134, April, 1914.*)

Q. 8.—What is the duty of the triple valve?

A.—To apply and release the brakes, and to charge the auxiliary reservoir. Or another explanation is that it controls the flow of air from brake pipe to auxiliary reservoir, from auxiliary reservoir to brake cylinder, and from brake cylinder to the atmosphere.

Q. 9.—Explain the duty of the triple piston, slide valve, graduating valve, emergency valve and check valve.

A.—The triple piston controls the feed groove and the movements of the graduating and slide valves. The slide valve controls the flow of air from auxiliary to brake cylinder, and from brake cylinder to exhaust; it also controls the emergency port. The graduating valve controls the graduating port. The emergency valve controls the flow of air from train line to brake cylinder in an emergency application of the brake. The check valve prevents the flow of air from the brake cylinder to brake pipe when brake pipe pressure is reduced below brake cylinder pressure.

Q. 10.—How many different types of triple valves are used on this road?

A.—Four: Plain; quick action, style H; quick action, style K, and "L" triple.

Q. 11.—What is the duty of the engineer's brake valve?

A.—To control the air from main reservoir to brake pipe, and to control the flow of air from brake pipe to atmosphere.

Q. 12.—Name the different positions of the brake valves: (G-6), (H-6).

A.—(G-6) full release, running, lap, service and emergency. (H-6) full release, running, holding, lap, service and emergency.

Q. 13.—Name the two different types of independent brake valves used.

A.—(S-6) independent, and the straight air brake valve (S-3-A).

Q. 14.—Where does the main reservoir pressure begin and end? Where does the brake pipe pressure begin and end?

A.—The main reservoir pressure begins at the top side of the discharge valves in pump and ends at the rotary valve in the brake valve. The brake pipe pressure begins at the rotary valve in the automatic brake valve and ends at the triple piston.

Q. 15.—What is the duty of the feed valves?

A.—To control brake pipe pressure.

Q. 16.—In what positions of the brake valve is the feed valve in operation?

A.—The running and holding positions

Q. 17.—Describe the operation of the feed valve?

A.—Main reservoir air enters the supply valve chambers and forces the supply valve piston over, compressing the spring and opening the supply port, so the main reservoir air can flow direct into the feed valve pipe until the pressure in the feed valve pipe compresses the diaphragm and regulating spring, allowing the regulating valve to seat and cut off communication between the chamber, back of the supply valve piston and the feed valve pipe, so that the small volume of main reservoir air flowing by the piston head will soon be equalized with main reservoir pressure, and the supply valve piston spring moves the piston and supply valve to the closed position.

Q. 18.—What is the purpose of the hand wheel and stops on (B-6) feed valve?

A.—So that the brake pipe pressure may be changed accurately by the engineer, through moving the hand wheel from stop to the other.

Q. 19.—What is the difference between a feed valve and a signal reducing valve?

A.—The principles of operation are the same, but, while the feed valve controls brake pipe pressure and is adjusted for that pressure, the reducing valve is adjusted for a pressure of 45 pounds generally and controls the air signal and independent brake valve pressures.

Q. 20.—For what purpose and where are safety valves used on locomotives?

A.—The safety valves are used with the S-W-A and S-W-B brakes and are connected with the brake cylinder to prevent the brake cylinder pressure being excessive; they are adjusted at 53 pounds. Safety valves are also used with the E-T brake attached to the distributing valve and are in communication with the application cylinder in all positions of the brake except the service lap, and by keeping the application cylinder pressure at a safe limit they prevent the brake cylinder pressure being excessive; they are adjusted at 68 pounds.

Q. 21.—When should the feed valve be cleaned and lubricated?

A.—On the first indication of sluggish action, and at least once in three months; some will not run over one month.

Q. 22.—What is the purpose of auxiliary reservoirs on locomotives and tenders?

A.—To carry a supply of compressed air to be used in the brake cylinders on an engine in an automatic application of the brakes.

Q. 23.—Are engines with the E-T type of brake equipped with auxiliaries?

A.—No.

Q. 24.—Can the driver brakes and tender brakes be released with the (S-6) independent brake valve after an automatic application? with the (S-3-A) independent valve?

A.—Yes, the brake can be released with either brake valve, after an automatic application has been made.

Q. 25.—What pressures do the red and black hands of air gauges indicate?

A.—The red hand on duplex gauge No. 1 indicates main reservoir pressure, and the black hand indicates the pressure above the equalizing piston, or, as it is termed, chamber D pressure. The red hand on duplex gauge No. 2 indicates the brake cylinder pressure, and the black hand indicates brake pipe pressure.

Q. 26.—Does the black hand of gauge indicate brake pipe pressure at all times?

A.—No, only at the time when brake pipe and chamber D pressures are equalized.

Q. 27.—What pressures are indicated on the small gauge?

A.—Brake cylinder by the red hand, and brake pipe by the black hand.

Q. 28.—At what pressures are the safety valves set when used with the standard equipment (A-1)? with (E-T) equipment?

A.—At 53 pounds with standard (A-1), and at 68 pounds with the (E-T).

Q. 29.—Why is a cut-out cock placed on each engine in the brake pipe close to the brake valve? When is it cut out? When is it cut in?

A.—To be used in double heading service, on engine which is second in the train or does not have control of the brakes, to close communication between brake pipe and the main reservoir or other apparatus on the engine. It is cut in when brakes on train are being handled by the engineer in charge of the engine. It is cut out when the brakes on train are being handled from another engine.

Q. 30.—Explain the difference between an angle cock and a cut-out cock, and where used.

A.—An angle cock has the body turned at an angle of 45 degrees for the con-

venience in making the hose connections; the body of the cut-out cock is straight, and is used in pipe connections. The angle cock is used at the end of the brake pipe where the brake pipe hose connections are attached; the cut-out cock is used in pipe lines leading to various parts of the brake apparatus on engines and cars.

Q. 31.—What is the duty of the pressure retaining valve? How many different kinds in use?

A.—The pressure retaining valve's duty is to retain pressure in brake cylinder on long grades while re-charging the auxiliaries. There are two different kinds of pressure retaining valves.

Q. 32.—Would the absence of a retainer render the brake on a car inoperative?

A.—No.

Q. 33.—What is the proper piston travel for driver brakes?

A.—About 4 ins. for driver brake, and 7 ins. for tender brake.

Q. 34.—Can a plain triple valve on driver or tender brake cause train brakes to go into quick action when a service application is being made? Why?

A.—No. Because it cannot cause any sudden reduction of train line pressure, and has no quick action parts.

Q. 35.—Trace the air through the air brake system.

A.—Air enters the pump through the receiving ports, and it passes by the receiving valves into the air cylinder. There it is compressed and forced out by the discharge valves and discharge ports, and through the discharge pipe into the main reservoir, and passes from main reservoir through the main reservoir pipe to the feed valve; then through the feed valve pipe to the feed valve port in rotary valve seat and up into cavity in rotary valve face; then down through brake pipe port in rotary valve seat to brake pipe, and through brake pipe and cross-over or branch pipe to the triple valve, it enters the triple piston cylinder through the ports in cylinder cap, then passes through feed groove to slide valve chamber and into the auxiliary reservoir, charging it to an equalization with brake pipe pressure. In response to a brake pipe reduction the auxiliary pressure moves the triple piston; this opens the graduating port and moves the slide valve to service position, so the graduating port registers with brake cylinder port and air flows from the auxiliary reservoir through graduating and brake cylinder ports into the brake cylinder applying the brake. In response to an increase in brake pipe pressure the triple piston is moved to the release position and the exaust cavity in slide valve connects the brake cylinder port with the exhaust port, allowing the air which was used in the brake cylinder to pass out to the atmosphere.

Movable Water Tables.

"Speaking about the trouble with brick arches," remarked a well known master mechanic, "why can't we use a water table in place of the arch that could be removed when work had to be done on the flues? It seems to me that designing such a table would not involve much structural difficulty."

These remarks illustrate the tendency of minds to fall into the same note of fallacy that others have wandered into. To substitute a movable water table for a brick arch which offers obstruction to work on the fire-box sheets or flues seems a very obvious way to surmount a difficulty, but applying such a water table is not an effectual remedy. It has been in the writer's line of experience to see movable water tables applied by three or four different inventors, and the first trial proved the last in every case. The steam generated within the table keeps the water from filling the apex and the sheets soon burn out. We would advise people wishing for information about movable water tables to apply to Mr. W. H. Lewis, S. M. P. on the Norfolk & Western.

Said the Time Was Too Fast.

In the early days of the Erie, which was the first railroad put in operation three hundred miles in length, the engineers and conductors took upon themselves the entire management of the train service. They frequently quarrelled grievously among themselves, and their disputes were sometimes highly inconvenient to the company, but they would yield no item of the authority to manage the train service, until Charles Minot was appointed superintendent.

Mr. Minot was a Boston lawyer with strong natural affinity for mechanics. He learned to run a locomotive and to operate telegraph instruments. Railroad life became so alluring to Mr. Minot that he gave up a good law business to become a railroad man. One of his first acts on becoming superintendent of the Erie was to compile a complete set of rules for train operating. This had not been done before and the rules arranged by Mr. Minot became the foundation on which nearly all American railroad rules were based.

These rules were of a highly practical character and every one of them was made to be obeyed. They made no provision for the engineers and conductors to interfere with the management, and on that account were highly unpopular. But Minot was a positive man and the rules had to be obeyed.

One time Mr. Minot arranged a new time schedule, shortening the time between Claremont, the Eastern terminus, and Dunkirk, on Lake Erie. The passenger engineers and conductors, as usual, proceeded to discuss the new time card and they made up their minds that the time was too fast and sent to Mr. Minot their opinion on the matter. The morning that the first train was to be run upon the new schedule Mr. Minot was waiting when the engine backed to the train at Claremont and he climbed to the cab. He notified the engineer that his services were not required that day and he ran all the engines on the different divisions till Dunkirk was reached and went there on time. In each case he kept the engineer behind.

After performing that feat he brought all the engineers concerned to Claremont for a talk. "Now, boys," he said, "you tell me that this time cannot be made. You have seen what I have done. If you are still of the opinion that the time is too fast the freight men will take your places, and you may go to some road where the trains run slower."

None of them left the Erie.

Old Fashioned Train Control.

The Mohawk & Hudson Railroad connected the two towns of Albany and Schenectady, and was 17 miles in length, but that portion which was operated by steam was only 14 miles long, horses being used on the inclined plane division from top of one hill to the top of another. In those days, the only brake used consisted of a wooden wedge which was dropped in between the wheels and the end of the truck frame when the train was about to commence the descent of a grade. When the train approached a station the station agent met it as it neared the station platform, placed the wedge in position, and when the time for starting arrived he removed the wedge and the train sped on its course.

This crude way of controlling a train led to accidents, and improvements were called for. The first improvement consisted of placing a strip of leather on one side of the wedge to increase the wearing qualities. On one end of the wedge was a hole in which a broom handle could be inserted for convenience in operating the contrivance. The next brake improvement introduced was the regular stage coach brake operated by the foot. This was about 1841.

As business increased and cars were added to the trains it was found impossible for the engineer to see how all the cars of his train were behaving, as a guard was placed on top of the front car with his back to the engine, and his duty was to give notice when any car jumped the track. That condition was made apparent by the bobbing of the car as it pounded over the ties.

We who pray should ask God to save us from any increased prosperity; we have all we can stand.

Air Brake Department

Universal Valve Disorders.

Continuing the subject of defects that the universal valve is liable to develop in service, provided that it is neglected for a sufficient length of time, we would first call attention to the operation of the service reservoir charging valve. This is a differential valve, the smaller portion being exposed to emergency reservoir pressure, the larger end to auxiliary reservoir pressure, and it controls the charging of the service reservoir.

The service reservoir is charged from the emergency reservoir, but not until such time as the auxiliary pressure is nearly equal to emergency reservoir pressure. When the pressures are approximately equal, the auxiliary pressure effective on the larger area of the charging valve is able to lift it from its seat and open the charging port.

When brake pipe pressure is first admitted to uncharged reservoirs the compressed air flows as explained in connection with the operation of the universal valve, and as the auxiliary charges faster than the service reservoir, and both charge approximately in one-half the time required to charge the emergency reservoir, it follows that the charging valve cannot be held closed when the system is first charged up.

The charging valve then connects these reservoirs until any material drop in auxiliary pressure permits the emergency pressure to close the valve. This occurs as soon as the valve moves to application position as auxiliary pressure drops by expansion into the brake cylinder, and at such times service and auxiliary reservoirs are connected through the equalizing slide valve seat, and the emergency reservoir is cut off from the service operation by the closed charging valve, the emergency charging port check valve, and by the release slide valve, that is, the check valve prevents a back flow of emergency pressure into the brake pipe until the release slide valve moves at which time it closes the emergency charging port between the check valve and reservoir.

It will be understood that with the graduated release cap in direct release position the graduated release port is closed, and emergency pressure cannot flow into the auxiliary reservoir for recharge therefore the auxiliary charges from the brake pipe during what is termed the transition period which is the time during which the triple valves are being replaced with universal valves.

As the magnet portion is also omitted during this period, at least on most of the cars, it is desired to deal only with pneumatic disorders, and the pneumatic features should be thoroughly understood before the electric portion can be considered.

If we were then to find a car upon which the brake would not apply with a service application, we would first ascertain whether the reservoirs were fully charged, then that the brake valve is free in the discharge of brake pipe pressure, then that the required rate of reduction is taking place in the brake pipe. Assuming the graduated release cap to be in direct release position, the auxiliary could fail to fully charge due to a restricted feed groove or due to a leak which taxed the capacity of the groove. Such an auxiliary leak would prevent the auxiliary pressure from reaching the maximum and thus fail to open the service reservoir charging valve and charge the service reservoir.

The service reservoir could fail to charge due to restrictions in the ports or due to a stuck or inoperative charging valve.

The failure of the auxiliary to charge would naturally prevent a service application of the brake and the auxiliary leak, if of sufficient volume to reduce auxiliary pressure in combination with the back flow through the feed groove, at about the same rate of brake pipe reduction, the equalizing piston would not move.

With the auxiliary fully charged, an uncharged service reservoir would prevent the service application as the equalizing piston moving to application position connects the service and auxiliary reservoirs hence the auxiliary pressure would expand into the service reservoir instead of both reservoirs expanding the compressed air into the brake cylinder.

The reservoirs being fully charged, and the brake valve exhausting the usual volume, the failure to obtain the proper rate of brake pipe reduction might be due to a leaky emergency reservoir charging valve which would permit emergency reservoir pressure to flow back into the brake pipe and thus tend to prevent the service application. It will be observed that after the release piston moves to application position the check valve will be cut off and its leakage cannot thereafter affect the brake.

The above is more a matter of observation than test, and if apparently everything so far is correct, the failure of the brake to apply in service may be due to a leaky brake cylinder packing leather or gasket which would be tested for in the usual manner.

If no pressure passes the leather or rather if no blow can be detected, it will indicate that the equalizing piston has not moved under conditions that it should have moved to application position, and it would point to a stuck or badly leaking packing on the equalizing piston or a broken or stuck piston.

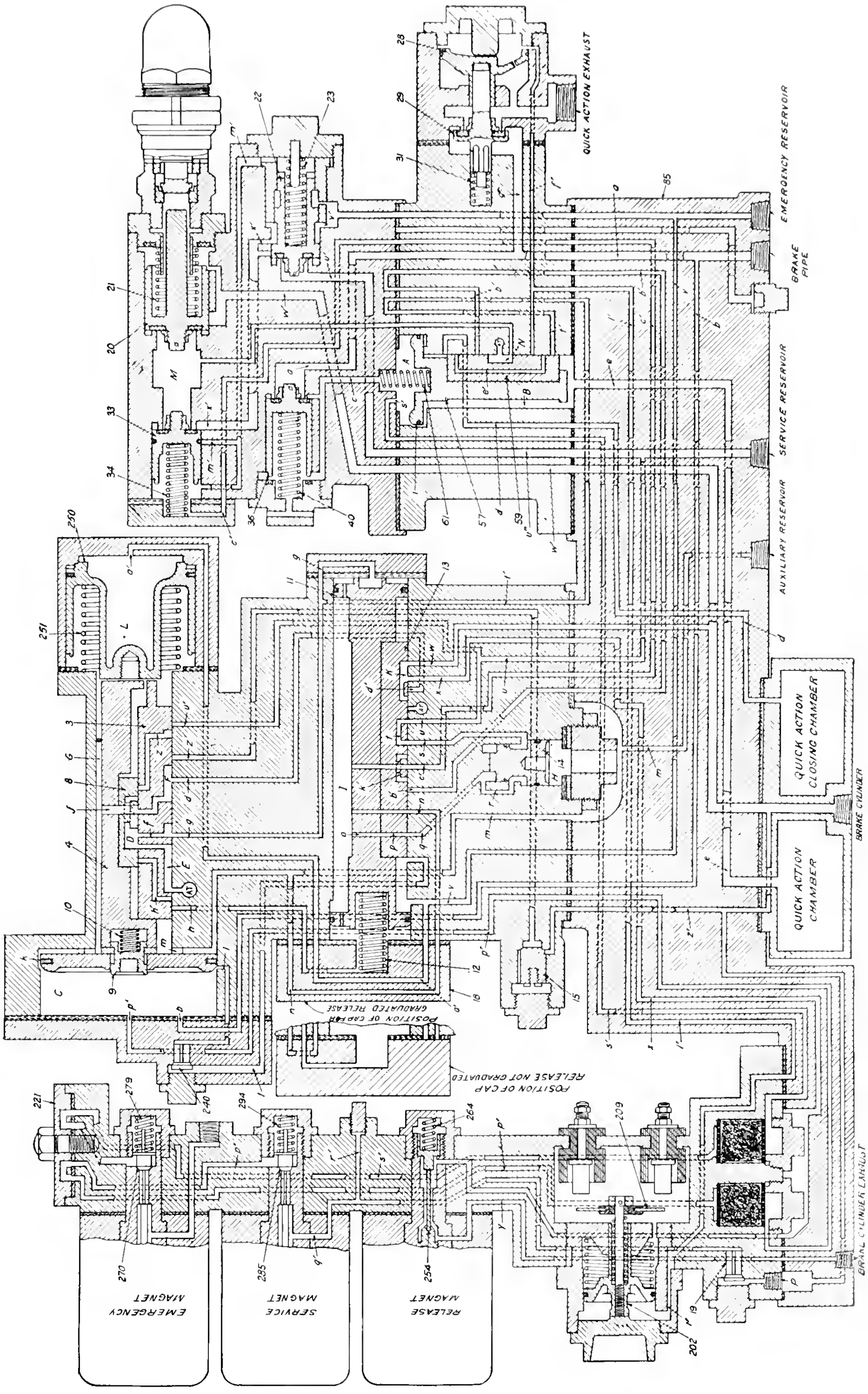
Should the failure to apply be accompanied by a heavy blow from brake cylinder exhaust port, it would indicate that the equalizing piston has moved but that the release piston has not. This would be due to excessive friction on the release piston or to an air tight fit of packing ring and a closed port at the release end of the piston. In the latter case it is assumed that there will be no pressure at the release end of the release piston and its operation depends upon a differential of pressure, therefore under the conditions cited there would be no difference in pressure wherewith to produce the movement.

It would be possible for a stuck shut service port check valve to prevent the service application of the brake, but it is very improbable. Under such circumstances the short exhaust from the equalizing valve exhaust port, and no blow at the brake cylinder exhaust port will indicate that both valves have moved to application position and an examination of the service port would be in order, assuming, of course, that no escape of brake cylinder pressure to the atmosphere could be detected.

Thus far it is assumed that the brake will not apply in service but that it will apply in emergency, if the brake could not be applied either in service or emergency, we would expect to find the brake cut out, either by the brake pipe or brake cylinder stop cock, otherwise the brake pipe or brake cylinder passages in the valve or bracket must necessarily be closed to prevent entirely any operation of the brake.

While a stuck release piston would prevent either operation of the brake, both by holding the brake cylinder open to the atmosphere and by maintaining emergency reservoir pressure back of the high pressure valve, it would not prevent the movement of the emergency piston and consequently the transmission of quick action would take place.

In order for a universal valve to be in such condition as to give no response



UNIVERSAL VALVE DIAGRAMMATIC.

whatever to an emergency application. Both the equalizing and emergency pistons would have to be blocked solid in their release positions.

If the brake applied with a service application, but leaked off after a few seconds time, we would observe whether it leaked brake cylinder pressure to the atmosphere or whether it released through the brake cylinder exhaust port.

If it merely leaked off, it might be past the brake cylinder leather, through the cylinder gasket, the brake cylinder pipe, past the seat of the safety valve, through the emergency piston exhaust or through the brake cylinder exhaust.

If the leak was through the emergency piston exhaust, it would be due to a defective seat on the cut off valve. If from the brake cylinder exhaust, it would indicate a leaky release slide valve.

It is possible but not probable that a leaky cap nut of the service port check valve would cause the brake to leak off.

If, however, the failure to remain applied after a service application is accompanied by a sharp exhaust from the brake cylinder exhaust port, it would indicate that the equalizing and release pistons have returned to their release positions, presumably through a leak in the auxiliary reservoir or through an increase in brake pipe pressure

If no leak could be found and brake pipe pressure did not increase, the release might be due to a leaky equalizing graduating valve or to an equalizing slide valve leak into the service port.

Whether a service reservoir leak would release the brake would depend somewhat upon the general condition of the equalizing piston and slide valve. If in good condition it might move toward release position only far enough to close the service reservoir port in the slide valve seat and cut off the service reservoir and prevent a leak in it from releasing the brake.

With the release from reservoir leakage, it is understood that the graduated release cap is in direct release position, otherwise the movement of the equalizing valve toward release position would open the graduated release port and emergency reservoir pressure would immediately return the equalizing valve to graduated release lap position.

A combination of disorders in one valve might cause the release of another valve that is in perfect condition, but it would come under the heading of increase in brake pipe pressure. If an auxiliary leak were to cause a valve to move to release position, a leaky emergency reservoir check valve in the same universal valve could leak emergency reservoir pressure into the brake pipe and thus increase the brake pipe pressure and force other universal or triple valves to release.

It will be remembered that in order for this back leakage to release the brake, the brake must be in release on the car with the check valve leakage, otherwise the release slide valve would lap the charging port.

Should it require 10 or 12 pounds reduction to apply the brake, it would point to excessive friction in the equalizing portion.

Should the brake apply in full after a light brake pipe reduction, there being no noticeable drop in brake pipe pressure, it would indicate leakage from the emergency reservoir into the service reservoir, probably past the seat of the intercepting valve.

If the valve is in graduated release position, a full application after a light service reduction may be due to a leak from the emergency reservoir into the auxiliary past the graduated release piston and cylinder cap gasket, however, owing to a very close fit of parts this is not very likely to occur.

In the event of a failure of the brake to release, we would first note the position of the graduated release cap, then observe whether the failure to release is accompanied by an exhaust from the exhaust port of the universal valve.

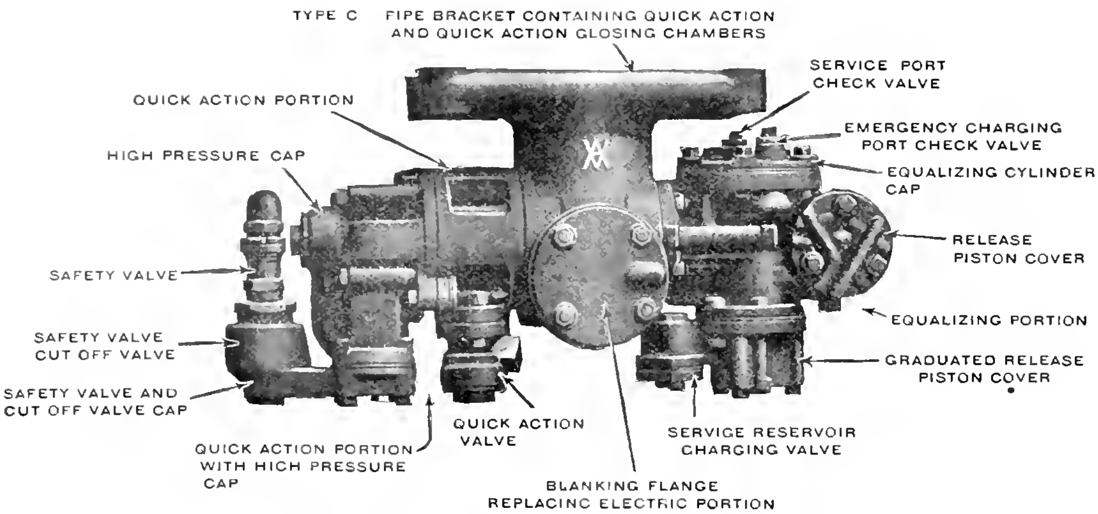
If the exhaust occurs, it would be safe to assume as with the triple valve, that either the hand brake is set, the brake rigging is fouled or that the brake cylinder release spring is broken.

If there is no exhaust, we would think first, that the reservoirs have been overcharged, or that brake pipe pressure has not been raised high enough to warrant a release.

After bleeding off the brake, re-applying and knowing that there has been no overcharge, and that brake pipe pressure is high enough to accomplish a release under ordinary circumstances, should the brake again fail to release, it would be well to notice whether there is any movement whatever of the equalizing portion which will be indicated by exhausts of pressure from the exhaust ports when the equalizing slide valve moves.

If there is no escape of air pressure from the equalizing slide valve exhaust port, it will indicate that the equalizing valve has not moved due to excessive friction. If there is a sharp exhaust from the release slide valve exhaust it will indicate that the equalizing slide valve has at least moved as far as graduated release position. Under such conditions the failure to move would be on the part of the release piston.

The release piston could fail to move due to excessive friction, a stopped-up port between the equalizing slide valve and the release end of the release piston, or due to a stopped-up port in the application end of the release piston accompanied by an air-tight fit of packing ring at the same application end of the release piston. This latter disorder would prevent a difference of pressure necessary to operate the release piston.



UNIVERSAL VALVE, U. C. EQUIPMENT.

The reason why a leaking equalizing piston packing ring is not mentioned in connection with failure to release is because it would tend to prevent the application rather than the release of the brake. Because of small auxiliary reservoirs, a comparatively rapid rise in brake pipe pressure is possible, and the small auxiliary volume depended upon to operate the equalizing piston, while ample for the purpose, is still of such proportion that the leaky ring would likely affect the application rather than the release of the brake. It will be understood that if any movement toward release position can be affected the bleed port from the auxiliary to the atmosphere will be opened and bleed off the brake as positively as though the bleed cock in an auxiliary reservoir were opened to bleed off a triple valve.

Undesired quick-action cannot be caused by the equalizing portion, if this disorder does occur and is positively traced to a universal valve, it would be due to a stopped-up feed groove in the emergency piston. In this event quick-action chamber pressure could not expand through the groove into the brake pipe at the same rate of service brake pipe reduction, consequently the emergency piston would be moved to emergency position. This is on the assumption that the quick-action chamber would be charged through the inevitable leakage past the packing ring of the emergency piston.

If the universal valve fails to work in quick-action in an emergency application the emergency piston may, or may not, have moved. In this event both the emergency and quick-action pistons should be examined. As these quick-action and quick-action closing chambers are located in the universal valve bracket, there is very little opportunity for any leakage to affect the emergency action of the brake, therefore it would be reasonable to assume that one of these pistons has stuck in its bushings.

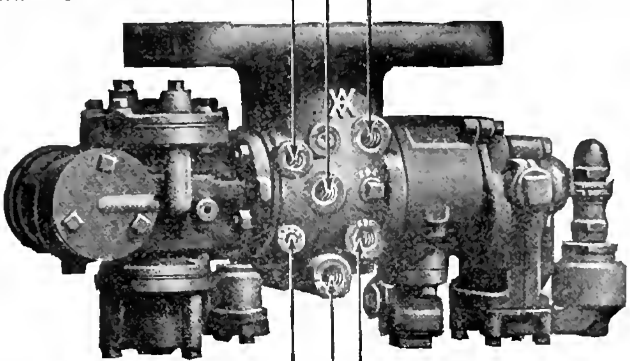
It will be observed that quick-action is transmitted through a brake pipe discharge through the quick-action exhaust port, therefore failure to obtain this discharge would indicate that quick-action has failed.

Failure to release after an emergency application, accompanied by a heavy discharge through the quick-action exhaust port indicates that the quick-action piston has stuck open or that for some reason the quick-action valve has not returned to its seat. A defective quick-action valve spring would tend to prevent the return of the quick-action valve to its seat.

It will be understood that the foregoing disorders of the universal valve are mostly possibilities as the greater portion referred to has not as yet developed, and if the universal valve is given the same amount of care as a triple valve now receives, a great many of the disorders will never develop.

To date no air brake equipment ever designed for steam road service has given as good results as the universal equipment and it absolutely does prevent stuck brakes, brakes creeping on and undesired quick-action. After nearly a year in service nothing of a serious kind has developed and while some instances are known in which pieces of foreign matter have lodged under a valve seat, particularly under the cut-off valve and release slide valve, the former merely causing a brake cylinder leak and the latter being caused by an improper bleeding of reservoirs, no delays or air brake troubles have been experienced in the operation of the brake under the conditions referred to.

A very few cases of slid flat wheels were encountered on cars so equipped, but could not be traced to any disorder of the universal valve, however, some slid flat wheels may reasonably be expected in any mixed service, as the more efficient the brake the nearer the approach to the point of wheel sliding.



UNIVERSAL VALVE, U. C. EQUIPMENT.

Signal Whistle Disorders.

The No. 6 E. T. locomotive brake has now been in general use about eight years, and while many changes have been suggested, it is still intact and admitted to be a practically perfect engine brake. On passenger engines, the supply of air for the train signal system is taken from the reducing valve pipe to the independent brake valve, and the rate of feed is controlled by a choked passage non-return check valve which makes unnecessary the use of a separate reducing valve for the signal system, but because of a lack of correct maintenance of the signal apparatus, some railroads have concluded that the E. T. signal equipment is inherently faulty and have gone back to a separate reducing valve for the signal line.

While this may give some relief from an unnecessary or undesired blowing of the whistle it does not repair or correct the disorder that is causing the blast of the whistle. In following up signal system repair work, the repairmen sometimes appear to lose sight of the fact that an undesired blast of the whistle means that a reduction in signal line pressure has taken place and that the same reduction was at a more rapid rate than the volume of compressed air under the diaphragm of the signal valve could flow past the diaphragm stem of the signal valve and expand into the signal pipe.

The idea is to then first stop this reduction in pressure before deciding the E. T. system is worthless, then know that the reducing valve is in a condition to supply any leakage that might result in a blast of the whistle.

The former is a matter of having signal pipes and check valves free from leakage, and to keep them tight is an exceedingly difficult matter with many of the special signal line couplings that are used between the engine and tender. In many cases it has been necessary to discard these couplings and use the W. A. B. Co. standard coupling in order to prevent this leakage and consequent trouble from unnecessary blowing of the whistle.

It is necessary to have the reducing valve sensitive enough to promptly supply any material drop in signal line pressure and in the reducing valve pipe and constantly maintain this pressure if there is to be no trouble with the whistle and under average conditions this is sometimes difficult and frequently next to impossible, because those in charge will not recognize the importance of absolutely accurate repair work on feed valve and reducing valves, the result is brakes sticking, flat wheels, and signal troubles.

What may be said concerning the reducing valve also applies to the brake pipe feed valve, as both are of the same construction and the feed valve must be equally accurate to prevent any brake pipe variation and the consequent sticking of brakes.

It is understood that the supply and regulating valves must first be free from leakage, the ports and passages fully open, and the supply and regulating valves a perfect fit. The supply valve piston cannot be a correct fit in a worn bushing, because in order to obtain the fluctuation in pressure when working against a 3-64 opening to the atmosphere requires too neat a fit at some point in the worn bushing in order to compensate for leakage past the worn parts, and the result will be a sticky piston after a short time in service. A feed valve or reducing valve may, due to a worn bushing, pass a rack test and become inoperative as soon as placed under a much higher temperature in an engine cab. Under present day conditions, the most critical point of maintenance is the supply valve piston and bushing, and a very close second is the fit of the regulating valve. This must be of correct length, flush with the diaphragm shoulder, perfectly straight and *a neat sliding fit in the regulating valve bushing.*

If the regulating valve has any considerable amount of side play an unreliable feed valve will be the result, on account of the valve failing to seat squarely after each operation in service which may be several hundred times per minute.

It is not desired to deal with repair or test work, but in order to eliminate signal whistle disorders and incidentally a considerable number of cases of brakes sticking, these pressure controllers must be practically perfect, and about the only way to know when this is being done is to faithfully follow up the refitting of the valves and observe the action of the valve on the test rack.

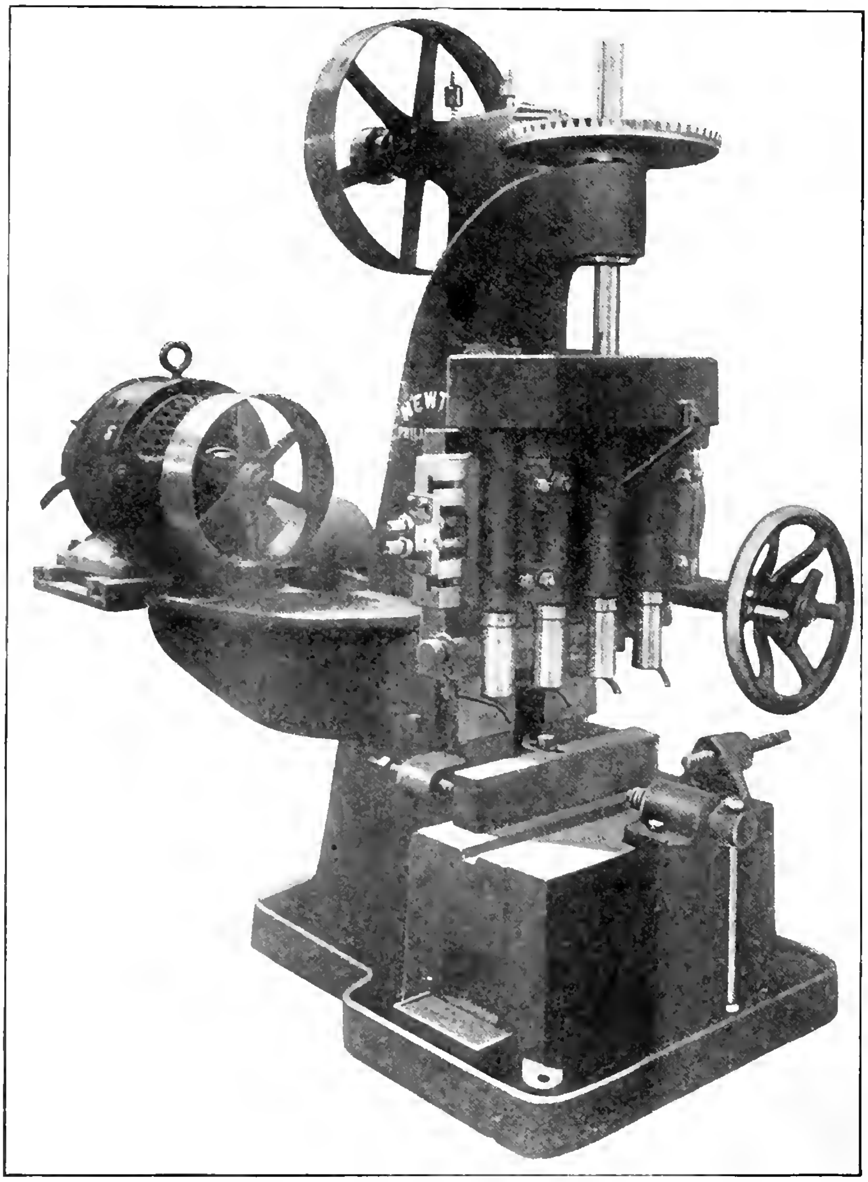
The fluctuation against a 3-64 opening to the atmosphere from a 10 x 33 reservoir volume should not be more than about one pound, or merely enough to be noticed on the gauge, should control either a small or large volume at exactly the same pressure and not show an increase in pressure when changing from the large to the smaller volume. In addition to the capacity test, the cock in the supply pipe should be thrown wide open after both a 5 and 10 lb. reduction in pressure, and not permit of more than a one or two pound overcharge, that is it should cut off promptly within two pounds of its adjustment. This may appear somewhat difficult, but there is much less trouble and expense attached to correct or perfect maintenance of the feed valve and reducing valves, than there is in attempting to maintain them in a haphazard fashion.

When an engine is turned out of the shop, we know that leakage in the brake pipe and signal system is going to develop, otherwise it would not be necessary to inspect and test the pipes at the end of every trip, therefore the reducing valve and feed valve must be in a condition to prevent the leakage from causing any drop in pressure until such time as it is discovered and remedied.

A New Rail Drilling Machine.

The Newton Machine Tool Works, Philadelphia, Pa., have perfected a new type of rail-drilling machine that possesses several new and interesting features. As shown in the accompanying illustration, the machine is equipped with four spindles, so that the three holes for the fish-plate bolts and the hole for the rail bond are all drilled at the same time. The three right-hand spindles are for the bolt holes, and these are arranged so that the distance between the centers of the holes can be adjusted from $3\frac{1}{2}$ to 9 ins. The left-hand spindle is for the rail-bond hole. It is kept at a constant distance of 6 ins. from the last bolt hole.

All the spindles are mounted on a saddle and can be moved vertically in unison. The saddle is counter-weighted and has two changes of power feed in addition to hand adjustment. A 10-horsepower Westinghouse electric direct-current motor furnishes the power. The motor is so placed that it does not interfere with the floor space and is conveniently near the operator. The materials are all of the best, and the construction has the high degree of excellence that marks the product of the Newton Machine Tool Works.



NEW TYPE OF RAIL-DRILLING MACHINE.

On the Lookout.

Mr. W. F. Lechlider, superintendent of the Baltimore & Ohio Railroad at Cleveland, directs the attention of his force to the action of Engineer Harrison Lynch, who runs an engine into the Cleveland terminal. The engineer, having heard a conversation between officials as to the possible saving in the use of mislaid materials, brought his engine into Cleveland after a recent run, with five angle cocks with air hose attached and nine hose clutches, which meant a saving of $15.95 to the company.

Like economics will be undertaken in a systematic manner by the railroad employees over all of the lines of the Baltimore & Ohio system.

Thermostatic Control of Steam Heating in Cars

The Gold Car Heating and Lighting Company, New York, has perfected an automatic system of controlling the inside

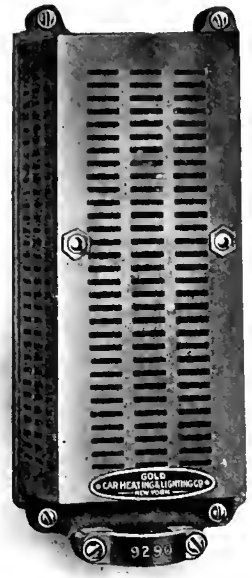


FIG. 1. ELECTRIC THERMOSTAT.

temperature of a car by appliances about 800 pounds lighter in weight than the system manually controlled by the opening and shutting of supply valves. The item of weight alone makes a difference of about $300 per car per year. Not only so but the new apparatus gives an automatic control which will practically hold the temperature in the car constant, as for example, when a car runs from a low altitude up into the mountains, or by the opening of doors or windows, will cause the thermostat to open the valve, and the warming of the car above this point will operate to close the valve.

The system comprises two special devices—an electric thermostat operating contacts by the expansion and contraction of a temperature, as shown in Fig. 1, and an electro-magnetic valve, Fig. 2. The thermostat is usually placed in a convenient location on the wall at the middle of the car, and the electro-magnetic valves are placed in the cross-over pipes on each side of the car underneath the seat as shown in Fig. 3, the three being connected by electric wires conveniently placed.

The electric operating current is so small that it is hardly perceptible and is obtained from the electric lighting circuit. The valve is in the normally open position and cannot leak as it has no stuffing box. It has been clearly proved that the device, whether used in connection with straight steam or with plain vapor systems, effects an enormous saving and the carrying of a much lower pressure on the train line. Cars cannot become overheated. It will work in connection with any Gold trap or vapor valve.

It may be stated that in some cases, on account of the car construction, it may be found necessary to place the electro-magnetic valves underneath the car on the cross-over pipe, leading from the train line to riser pipe. The operation of the valves is equally as efficient when placed in this position. It is also as readily adaptable to old as well as new cars, whether heated by vapor or straight steam, and the amount of steam saved by its use will pay for its installation in a very short time.

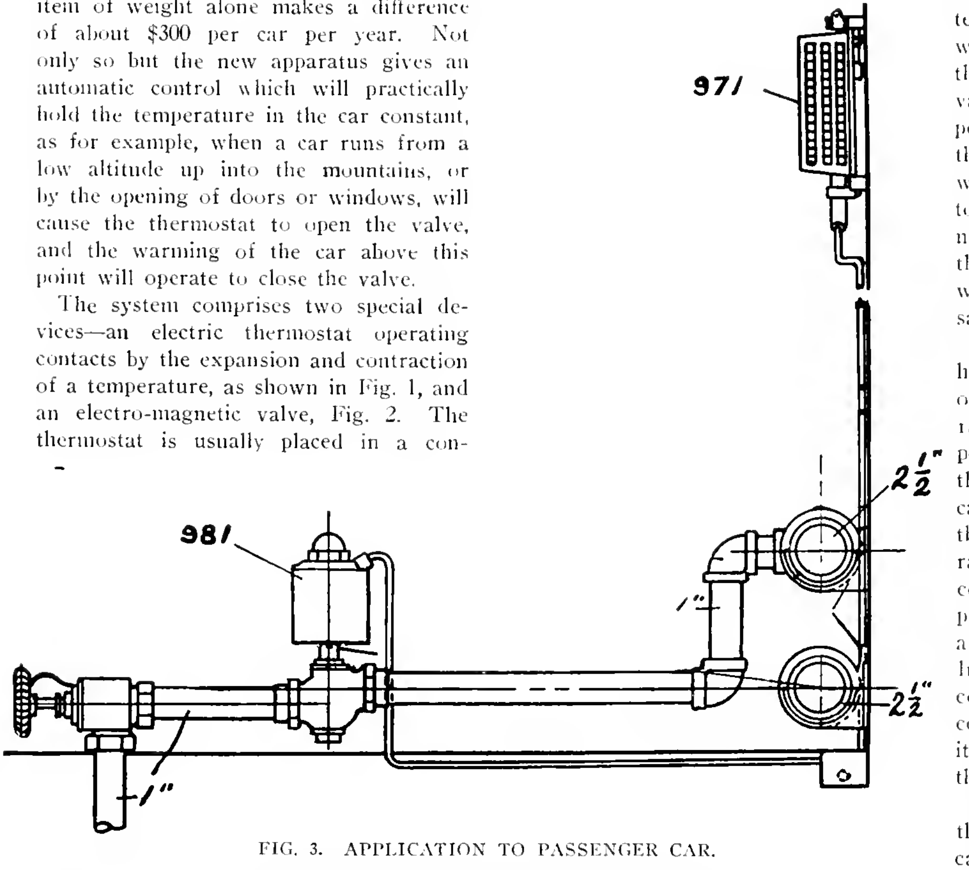


FIG. 3. APPLICATION TO PASSENGER CAR.

As an illustration, a series of tests were conducted on a number of the leading railroads in a variety of atmospheric conditions, it may be stated that with the thermostat set to open at 65 degrees and close at 70 degrees, and with a train line pressure varying from 30 pounds to 60

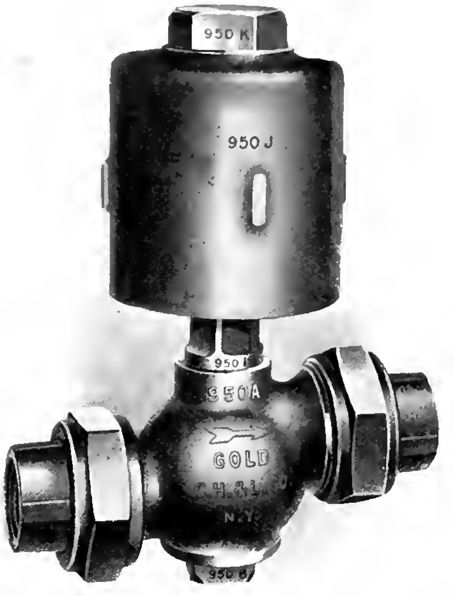


FIG. 2. ELECTRO MAGNETIC VALVE.

pounds, and an outside temperature ranging from 30 to 33 degrees, the inside temperature varied from 60 to 74 degrees, whereas, in the cars not equipped with the thermostat device the temperature varied from 60 to 92 degrees. During a period of 5 hours the car equipped with the thermostat condensed 338 pounds less water than the car not so equipped, the total amount of water condensed with the new appliance being 224 pounds, and in the car not using the device 562 pounds was used in the same time, showing a saving in steam of about 60 per cent.

In some tests the variations were much higher, as for example, during a period of 5 hours with the outside temperature ranging from 21 to 29 degrees, the temperature in the car equipped with the thermostat the temperature inside the car ranged from 68 to 75 degrees, and in the car not so equipped the temperature ranged from 68 to 96 degrees, with total condensations of 198 pounds and 566 pounds, respectively, of water, showing a saving in steam of about 83 per cent. In every instance the saving in steam consumption amounted to almost 60 per cent., and in the large majority of tests it amounted to considerably more than that figure.

In all cases the rear cars maintained the same temperature as the forward cars, and in the automatic system it required no attention whatever from the trainman, and at the same time insuring comfort to the traveling public.

Electrical Department

FP-310 500 7-3-13

RESUSCITATION FROM ELECTRIC SHOCK

Follow These Instructions Even If Victim Appears Dead

RULES RECOMMENDED BY
Commission on Resuscitation from Electric Shock
Representing
The American Medical Association
The National Electric Light Association
The American Institute of Electrical Engineers

DR. W. B. CANNON, Chairman, *Professor of Physiology, Harvard University*
DR. YANDELL HENDERSON, *Professor of Physiology, Yale University*
DR. S. J. MELTZER, *Head of Department of Physiology and Pharmacology, Rockefeller Institute for Medical Research*
DR. EDW. ANTHONY SPITZKA, *Director and Professor of General Anatomy, Daniel Baugh Institute of Anatomy, Jefferson Medical College*
DR. GEORGE W. CRILE, *Professor of Surgery, Western Reserve University*
MR. W. C. L. EGLIN, *Past President, National Electric Light Association*
DR. A. E. KENNELLY, *Professor of Electrical Engineering, Harvard University*
DR. ELIHU THOMSON, *Electrician, General Electric Company*
MR. W. D. WEAVER, Secretary, *Editor Electrical World*

Adopted By **GENERAL ELECTRIC COMPANY** October, 1912

I. Immediately Break the Circuit

With a single quick motion, free the victim from the current. Use any *dry non-conductor* (clothing, rope, board) to move either the victim or the wire. Beware of using metal or any moist material. While freeing the victim from the live conductor have every effort also made to shut off the current quickly.

II. Instantly Attend to the Victim's Breathing

1. As soon as the victim is clear of the conductor, rapidly feel with your finger in his mouth and throat and remove any foreign body (tobacco, false teeth, etc.). Then *begin artificial respiration at once*. Do not stop to loosen the victim's clothing now; *every moment of delay is serious.* Proceed as follows:

(a) Lay the subject on his belly, with arms extended as straight forward as possible and with face to one side, so that nose and mouth are free for breathing (see Fig. 1). Let an assistant draw forward the subject's tongue.

(b) Kneel straddling the subject's thighs, and facing his head; rest the palms of your hands on the loins (on the muscles of the small of the back), with fingers spread over the lowest ribs, as in Fig. 1.

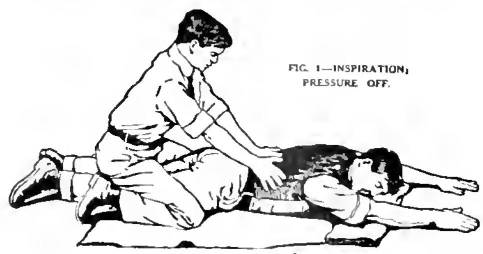


FIG. 1—INSPIRATION; PRESSURE OFF.

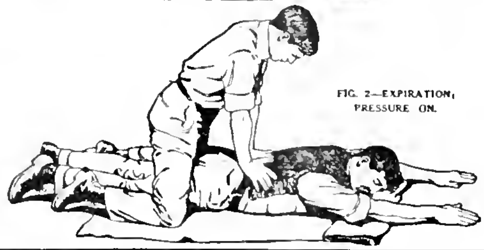


FIG. 2—EXPIRATION; PRESSURE ON.

(c) With arms held straight, swing forward slowly so that the weight of your body is gradually, but *not violently*, brought to bear upon the subject (see Fig. 2). This act should take from two to three seconds.

(d) Then immediately swing backward so as to remove the pressure, thus returning to the position shown in Fig. 1.

(e) Repeat deliberately twelve to fifteen times a minute the swinging forward and back— a complete respiration in four or five seconds.

(f) As soon as this artificial respiration has been started, and while it is being continued, an assistant should loosen any tight clothing about the subject's neck, chest or waist.

2. Continue the artificial respiration (if necessary, two hours or longer), *without interruption*, until natural breathing is restored, or until a physician arrives. If natural breathing stops after being restored, use artificial respiration again.

3. *Do not give any liquid by mouth until the subject is fully conscious*

4. Give the subject fresh air but keep him warm.

III. As Soon as Accident is Discovered

NOTES

An accidental electric shock usually does not kill at once, but may only stun the victim and for a while stop his breathing.

The shock is not likely to be immediately fatal, because

(a) The conductors may make only a brief and imperfect contact with the body.

(b) The skin, unless it is wet, offers high resistance to the current.

Hope of restoring the victim lies in prompt and continued use of artificial respiration. The reasons for this statement are

(a) The body continuously depends on an exchange of air, as shown by the fact that we must breathe in and out about fifteen times a minute.

(b) If the body is not thus repeatedly supplied with air, suffocation occurs.

(c) Persons whose breathing has been stopped by electric shock have been reported restored after artificial respiration has been continued for approximately two hours.

The Schafer or "prone pressure" method of artificial respiration, slightly modified, is illustrated and described in the above resuscitation rules. The advantages of this method are.

(a) Easy performance, little muscular exertion is required

(b) Larger ventilation of the lungs than by the supine method

(c) Simplicity; the operator makes no complex motions and readily learns the method on first trial.

(d) No trouble from the tongue falling back into the air passage.

(e) No risk of injury to the liver or ribs if the method is executed with proper care.

Aid can be rendered best by one who has studied the rules and has learned them by practice on a volunteer subject.

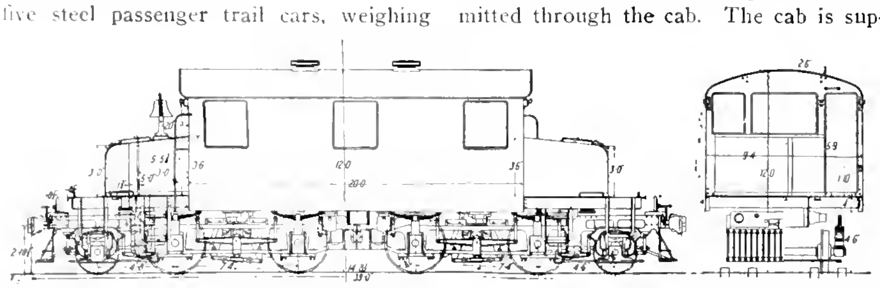
High Speed Passenger Locomotives.

OAKLAND, ANTIOCH & EASTERN RAILWAY, OAKLAND, CAL.

Business has increased so rapidly since the opening of the Oakland, Antioch & Eastern Railway that in order to cope with the heavy through passenger traffic between San Francisco and Sacramento it has been necessary to place in operation two 62-ton electric locomotives. The use of electric locomotives for hauling passenger trail cars, instead of using multiple-unit cars, is a new and noteworthy departure in the electric railway field. The phenomenal growth in traffic mentioned above is largely due to the opening up of new territory, which has been heretofore practically inaccessible to the Bay Cities except by long, round-about steam route.

The locomotives are of the 2-4-0 articulated truck type, and each is equipped with four Westinghouse No. 308-D-7, 250 h. p. 600-1,200-volt commutating pole motors, and type HLF unit switch control.

Each locomotive when operating at a balancing speed of approximately 56 m. p. h. is capable of hauling a train of five steel passenger trail cars, weighing 37.5 tons each, on a level tangent track with 1,100 volts direct current on the trolley. With only three of these cars, one of these locomotives under the same track conditions is able to attain a balancing speed of about 80 m. p. h.



SIDE AND END SECTION VIEWS OF ELECTRIC LOCOMOTIVES FOR THE OAKLAND, ANTIOCH & EASTERN RAILWAY.

The locomotive has two articulated trucks each having six wheels, four of which are drivers. These two trucks are connected together with an articulation link, so that no draw bar pull is transmitted through the cab. The cab is supported on the truck frames by 8 spring loaded friction plates, no weight being carried on the king pins, which are used simply to maintain the position of the cab.

The whole mechanical construction of

this locomotive is of the highest type. The two-wheeled radial trucks under the ends of the locomotive are of the modified Rushton type, with radius bars; buffers are provided to tend to restore alignment of the trucks after the curve has been transversed; the cab is of steel plate arranged for double end operation; all walking platforms outside the cab are of rolled steel checker plate; air sanders are provided for front and back; the driving wheels have cast iron centers with steel tires, while the truck wheels are of rolled steel. The principal dimensions are as follows:

Gauge—4 ft. 8½ ins.

Wheel Base—Rigid, 7 ft. 4 ins.

Wheel Base—Total, 31 ft.

Driving Wheels—Diam. outside, 42 ins.

Driving Wheels—Diam. center, 37 ins.

Driving Journals—5 x 9 ins.

Truck Wheels—Diameter, 30 ins.

Truck Journals—4½ x 8 ins.

Width over all, 10 ft.

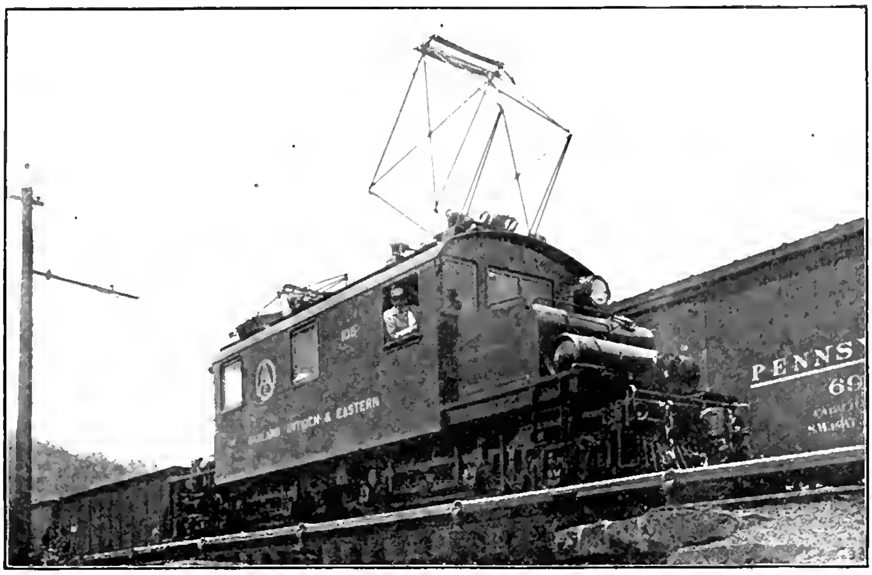
Height to top of cab, 12 ft.

Length center to center of coupler knuckles, 39 ft.

Weight on driving wheels, 86,000 lbs.

Weight—Total engine, 124,000 lbs.

Each locomotive is equipped with four Westinghouse, 250 H. P. motors of the interpole type, and H. L. control.



ELECTRIC LOCOMOTIVES FOR THE OAKLAND, ANTIOCH & EASTERN RAILWAY.

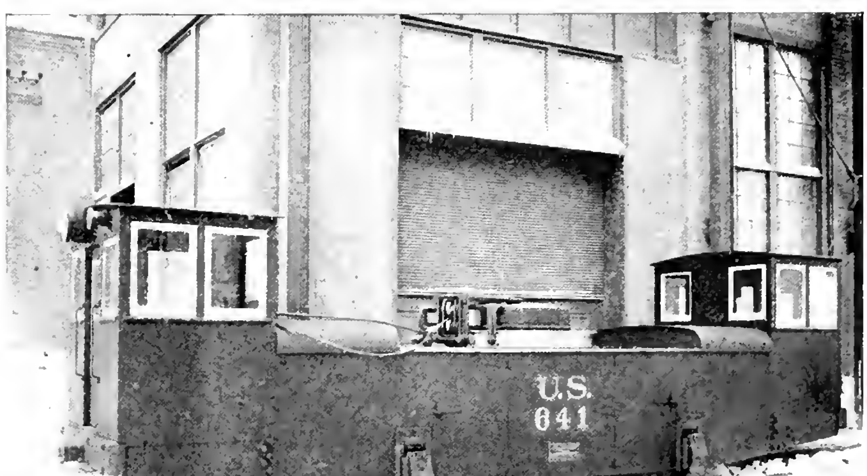
Electric Towing Locomotives for the Panama Canal Locks.

There will be forty electric locomotives used at the Panama canal to handle vessels through the locks. The first lot of these are now being received at the Isthmus. These "electric mules" are built by the General Electric Company for this purpose. They weigh 82,500 lbs.; are 32 ft. 2½ ins. over all; 8 ft. wide and 9 ft. 3 ins. high. They are capable of exerting a tractive effort as high as 47,500 lbs. In addition to the regular draw bar pull, the engine is fitted with a windlass rope and a pull of 25,000 lbs. can be obtained. Four of these engines, two on each side, will ordinarily propel steamships through the locks, and as many as six will be needed for the extra large vessels. In every case two locomotives will be used astern, acting as a brake on the ship's movements.

The locomotive, which is built up of cast steel side and end frames, has two axles. When towing it is propelled by means of a rack rail and it also uses this rack when going from one level to another at which place the grades are very steep. When using the rack a very slow speed of 2 miles per hour is obtained. The engine is so arranged that the pinion can be disengaged from the rack and the locomotive run in the usual way, when a speed of 5 miles per hour is obtained. This latter speed is only used when the engine is running light.

In the center of the locomotive is located a vertical windlass with drum, the capacity of which is 800 ft. of 1 in. steel hawser cable. The windlass with its driving motors and gearing is mounted on a solid baseplate and is likewise independent of the movement of the locomotive frame. The cable drum extends above the locomotive cover and has a floating guard placed around it to retain the cable while coiling loose.

The windlass cable is handled by two 20 horsepower motors, also totally enclosed and of the mill type. One is geared for a rope speed of 12 ft. per minute at a pull up to 25,000 lbs. at 2 ft. radius, and its function is to adjust the position of the ship for anchor or while being towed through the locks. The other motor is geared for a rope speed of 200 ft. per minute at 2 ft. radius, and its duty is to take up slack or pay out cable or wind in any part of the entire length of cable as may be required.



ELECTRIC LOCOMOTIVE FOR THE PANAMA LOCKS.

Preventing Rust.

To preserve steel from rust dissolve 1 part caoutchouc and 16 parts turpentine with a gentle heat, then add 8 parts boiled oil, and mix by bringing them to the heat of boiling water. Apply to the steel with a brush, the same as varnish. It can be removed again with a cloth soaked in turpentine.

Items of Personal Interest

Mr. J. J. O'Connor has been appointed signal supervisor on the Erie, with office at Salamanca, N. Y.

Mr. J. Dickson has been appointed master mechanic on the Oregon Electric, with office at Portland, Ore.

Mr. A. F. King has been appointed road foreman of engines on the Wabash, with office at Peru, Ind.

Mr. F. H. Buchanan has been appointed signal supervisor on the Vandalia, with office at Terre Haute, Ind.

Mr. F. Heins has been appointed master mechanic on the Gulf & Sabine River, with office at Fullerton, La.

Mr. G. H. Hopkins has been appointed master mechanic on the United Railway, with office at Portland, Ore.

Mr. C. T. Tillett has been appointed supervisor of signals on the Grand Trunk, with office at Montreal, Que.

Mr. H. B. Brown has been appointed general fuel inspector on the Illinois Central, with office at Chicago, Ill.

Mr. D. P. Phalen has been appointed locomotive foreman on the Great Northern, with office at Butte, Mont.

Mr. J. A. Sheppard has been appointed master mechanic on the Missouri Pacific, with office at Coffeyville, Kan.

Mr. C. G. Winslow has been appointed electrical engineer on the Michigan Central, with office at Detroit, Mich.

Mr. F. A. Bladorn has been appointed locomotive foreman on the Great Northern, with office at Billings, Mont.

Mr. W. P. Milon has been appointed locomotive foreman on the Great Northern, with office at Whitefish, Mont.

Mr. W. F. Hudson has been appointed signal inspector on the Louisville & Nashville, with office at Louisville, Ky.

Mr. B. J. Peasely has been appointed superintendent of shops on the Missouri Pacific, with office at Argenta, Ark.

Mr. F. M. Marely has been appointed roundhouse foreman on the Texas & Gulf, with office at Longview, Tex.

Mr. F. W. Murphy has been appointed master mechanic on the Chicago, Ottawa & Peoria, with office at Ottawa, Ill.

Mr. M. P. Hobran has been appointed road foreman of engines on the Baltimore & Ohio, with office at Dayton, Ohio.

Mr. C. E. Fowler has been appointed master mechanic on the Jefferson & North Western, with office at Jefferson, Tex.

Mr. W. W. Bolineau has been appointed road foreman of engines on the Central of Georgia, with office at Macon, Ga.

Mr. C. F. Barnhill has been appointed master mechanic on the Gulf, Colorado & Santa Fe, with office at Silsbee, Tex.

Mr. F. H. Bagley has been appointed signal supervisor on the Louisville & Nashville, with office at Louisville, Ky.

Mr. J. B. Harvard has been appointed general foreman on the Baltimore & Ohio Southwestern, with office at Flora, Ill.

Mr. F. Fisher has been appointed general foreman on the Chicago, Peoria & St. Louis, with office at Springfield, Ill.

Mr. W. H. Keller has been appointed general foreman on the Cincinnati, Hamilton & Dayton, with office at Lima, Ohio.

Mr. W. E. Boland has been appointed signal engineer on the Southern Pacific, with headquarters at San Francisco, Cal.

Mr. A. G. McLellan has been appointed foreman of locomotive repairs on the Chicago & Alton, with office at Bloomington, Ill.

Mr. W. A. Martin has been appointed general car foreman on the Bangor & Aroostook, with office at Milo Junction, Me.

Mr. G. Drolet has been appointed general engine foreman on the Bangor & Aroostook, with office at Milo Junction, Me.

Mr. C. M. Kelly has been appointed chief dispatcher on the Fort Dodge, Des Moines & Southern, with office at Boone, Ia.

Mr. A. C. Adams has been appointed superintendent of motive power on the United Railway, with office at Portland, Ore.

Mr. Thomas Long has been appointed roundhouse foreman on the St. Louis & San Francisco, with office at Harwood, Ark.

Mr. J. M. Davis has been appointed general manager of the Cincinnati, Hamilton & Dayton, with offices at Cincinnati, Ohio.

Mr. J. J. Gray has been appointed locomotive foreman in the Maritime Coal Railway & Tower Company, at Mines, N. S.

Mr. W. Graff has been appointed road foreman of engines on the Baltimore & Southwestern, with office at Chillicotte, Ohio.

Mr. F. S. Wynn has been appointed purchasing agent on the Virginia & Southwestern, with office at Washington, D. C.

Mr. F. Bauer has been appointed master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Indianapolis, Ind.

Mr. Oscar Stevens has been appointed road foreman of engines on the Baltimore & Ohio Southwestern, with office at Cincinnati, Ohio.

Mr. A. E. McMillan has been appointed assistant master mechanic on the Baltimore & Ohio Southwestern, with office at Cincinnati, Ohio.

Mr. G. K. Stewart, formerly master mechanic on the Missouri Pacific, at Coffeyville, Kan., has been transferred to De Soto, Mo.

Mr. H. C. Shillings has been appointed master mechanic and chief engineer on the South Manchester, with office at South Manchester, Conn.

Mr. C. A. Bandt has been appointed assistant master mechanic on the Cleveland, Cincinnati, Chicago & St. Louis, with office at Indianapolis, Ind.

Mr. F. A. Hamm has been appointed master mechanic on the Staten Island Rapid Transit, with office at Clifton (P. O., Stapleton, N. Y.)

Mr. W. H. Naylor has been appointed road foreman of engines of the Chicago & Alton, with office at Bloomington, Ill., succeeding Mr. W. H. Davis.

Mr. Charles Woodard has been appointed master mechanic on the Kansas City, Mexico & Orient Railway of Texas, with office at San Angelo, Tex.

Mr. D. J. Mullen has been appointed superintendent of motive power on the Cleveland, Cincinnati, Chicago & St. Louis, with offices at Indianapolis, Ind.

Mr. John Allen, formerly signal inspector on the New York, New Haven & Hartford, at New Haven, Conn., has been transferred to Bridgeport, Conn.

Mr. F. T. Hyndman, superintendent of motive power of the Wheeling & Lake Erie, has had his headquarters transferred from Cleveland, Ohio, to Brewster, Ohio.

Mr. John Simmes has been appointed general foreman of the Cincinnati, New Orleans & Texas Pacific, with office at Ludlow, Ky., succeeding Mr. J. G. Lewis.

Mr. A. H. Binns has been appointed master mechanic of the Ontario division of the Canadian Pacific, with offices at West Toronto, Ont., succeeding Mr. L. F. Hamilton.

Mr. W. F. Meyers, formerly foreman of bridges, buildings and water supply on the Chicago & North Western, at Belle Plaine, Ia., has been transferred to Boone, Ia.

Mr. R. D. Hutchings has been appointed roundhouse foreman on the Southern, with office at Selma, Ala., in place of Mr. G. W. Thomas, who has resigned on account of ill health.

Mr. John Benziges, formerly superintendent of locomotive operation on the

Chicago, Rock Island & Pacific, at Des Moines, Ia., has been transferred to Valley Junction, Ia.

Mr. J. S. Sheafe, formerly engineer of tests of the Illinois Central at Chicago, Ill., has been appointed master mechanic on the Baltimore & Ohio, with office at Clifton, Staten Island, N. Y.

Mr. Elbert J. Fuller has been appointed representative of the Hunt-Spiller Manufacturing Corporation, of Boston. Mr. Fuller was formerly connected with the Chicago & North Western, and resigned his position on that road to accept this new position.

Mr. O. B. Schoenky has been appointed shop superintendent on the Southern Pacific, Mr. D. S. Watkins has been appointed assistant shop superintendent, and Mr. J. P. Brendel has been appointed general foreman of car shops, all with offices at Sacramento, Cal.

Mr. A. T. Breecher has been appointed signal inspector on the Chicago, Milwaukee & St. Paul, with office at Marion, Ia., and Mr. P. A. Muncey has been appointed to a similar position at Millbank, S. D., and Mr. J. O'Connor has been appointed to a similar position at Spencer, Ia., and Mr. H. J. Thomas has been appointed to a similar position at Hastings, Minn., all on the same road.

Mr. J. H. Ruxton has been appointed superintendent of motive power of the San Antonio, Uvalde & Gulf, with offices at Pleasanton, Tex. Mr. Harry Jackson

FRANK H. CLARK.

was appointed general foreman of the locomotive department, in place of Mr. H. M. Warden, resigned, and Mr. A. F. Hawkins was appointed general foreman, car department, in place of Mr. W. H. Pinson, resigned, all with offices at Pleasantton, Tex.

Mr. Frank H. Clark, formerly sales manager in connection with the railroad department of the Watson-Stillman Company, has established a new company for the manufacture and sale of the Chambers throttle valve, with offices at 30 Church street, New York. Mr. Clark has had a wide experience in the railway supply business, having been in the em-

J. A. GORDON.

ploy of the Standard Coupler Company, T. N. Motley & Co. and others. Mr. Clark has been elected president of the new company, which will be known as the Chambers Throttle Valve Company. It will be remembered that the device is the invention of Mr. John Chambers, of the Atlantic Coast Line, and its rapidly growing popularity justifies Mr. Clark's establishment of a company to further advance the improved appliance in railroad use.

Mr. J. A. Gordon has been appointed general manager of the Chicago Great Western, with offices at Chicago, Ill. Mr. Gordon graduated from St. Xavier's College, Cincinnati, Ohio, in 1884, and entered railway service in the same year, since when he has served in the telegraph department of the Cincinnati, Hamilton & Dayton, and also in the auditing department of the same road, and was promoted to chief clerk on the same road, and also trainmaster and superintendent of divisions on the same road. In 1909 he was appointed general superintendent of the same, with office at Cincinnati. From March, 1910, to December, 1912, he was division superintendent on the Chicago & Great Western, and in December, 1912, he accepted a position as general superintendent of the Pere Marquette, which position he held until his present appointment. Mr. Gordon has traveled extensively in Europe, and is thoroughly conversant with railway matters, and is an acknowledged authority on railway transportation.

Mr. Walter Bentley, formerly with the Baldwin Locomotive Works and Standard Steel Works, has accepted a position as sales manager with the Curtain Supply Company of Chicago. Mr. Bentley has had a thorough training in various branches of railway service, having served in the different departments of the shops, as well as in the roadmaster's, general superintendent's and purchasing agent's offices. Mr. Bentley's father, Mr. H. T. Bentley, is the well-known superintendent of motive power of the Chicago & Northwestern, and the younger Mr. Bentley inherits much of his father's thoroughness in the knowledge of railway mechanical appliances.

Mr. George W. Kiehm, who conducts the Air Brake Department in RAILWAY AND LOCOMOTIVE ENGINEERING, is also employed as an air brake expert by the Washington Terminal Company. He is from Johnsburg, Pa., and entered the service of the Baltimore & Ohio in 1895. Since then he has had a wide experience on several of the Eastern railroads, particularly on the Annapolis, Washington & Baltimore, the Pennsylvania, and latterly on the Washington Terminal. As a writer on air brake subjects he is generally recognized as in the front rank of the leading experts in America. He has been attached to our staff since 1909. He modestly claims that his abilities as a writer are owing in a large measure to the kindly interest of Mr. W. V. Turner, of the Westinghouse company,

GEORGE W. KIEHM.

who was among the first to discover the rare merits of Mr. Kiehm's work. Many of the leading air brake instructors use Mr. Kiehm's monthly contributions to our pages as the leading feature of their instruction to the young railway men studying the air brake. His style is marked by a degree of clearness seldom reached by technical writers.

OBITUARY.

CY WARMAN.

Mr. Cyrus Warman, the well-known writer of railroad stories and verses, died in Chicago on April 7. He was born in Greenup, Illinois, in 1855. His early years were spent on a farm owned by his father. In 1880 he went to Colorado, where he worked as a locomotive fireman and engineer for eight years. He turned to journalism in 1888, becoming editor of *Western Railway*. In 1892 he was editing the *Creede Chronicle*. In 1893 he began contributing to the magazines. A number of his early productions appeared in

CYRUS WARMAN.

the pages of RAILWAY AND LOCOMOTIVE ENGINEERING. In 1895 his first book appeared, being "Tales of an Engineer." This was a collection of short stories and was followed by "The Express Messenger," "Frontier Stories," "The Story of a Railroad," "The White Mail," "Snow at the Headlight" and "The Last Spike." These were all pertaining to railroad experiences and were largely a reflex of railroad life in the West in the early days of railroading. In addition to these Mr. Warman also published a volume of verses, chiefly on railroad subjects. His style was graphic and direct, vivid in portraiture, and of fine literary fiber. In his later years he drifted back to railroading in the executive department of the Canadian Pacific. He was a genial and lovable character and warmly esteemed by all who knew him.

GEORGE F. BAER.

George F. Baer, president of the Philadelphia & Reading Railway, died at his home in Philadelphia on April 26.

George Frederick Baer was born, of German ancestry, in Somerset County, Pa., on September 26, 1842, and was educated at Franklin and Marshall College. Years before entering that institution, however, he worked as a boy, just in his teens, in the printing office of the *Somerset Democrat*, of which paper he and his brother afterward became the owners and editors. In 1862 he organized a volunteer company, of which he was made captain, and with it he fought with the Army of the Potomac, at the second battle of Manassas, at Chancellorsville and elsewhere, rising to the rank of adjutant general of brigade.

In 1864 he was admitted to the bar and settled at Reading, Pa., to devote himself to legal practice, chiefly for the railroads. There he became counsel for the Reading Railroad Company, and was offered a directorship, but declined it because of disagreement with President McLeod's policy.

Then he came to the attention of Morgan, who wanted some work done. Baer undertook to do it, and succeeded, and in 1901 Morgan made him president of the Reading Railroad. He was also made president of the Reading Coal and Iron Co., and of the Central Railroad of New Jersey, thus giving him direct control of the chief anthracite coal producing and shipping corporations of the country. He was also president of the Temple Iron Co., which was the mine owning corporation controlled by the coal roads.

In the anthracite coal strike of 1902 he was the spokesman for all the coal roads, and was practically the dictator on that side of the controversy. It was then that he made the remark that "the rights and interests of the laboring men will be looked after and cared for, not by agitators, but by the Christian men to whom God in His infinite wisdom has given control of the property interests of the country."

Personally Mr. Baer was intensely religious, charitable and almost ascetic in habits. He had a fine home in the outskirts of Reading, where he interested himself in farming and gardening. His favorite exercise was walking, and his pet diversion was at the chess board.

In the winter he made his home in Philadelphia, where his wife and five daughters were popular members of society.

NOTICE

Air Brake Convention

Arrangements are completed for holding the twenty-first annual convention of the Air Brake Association in the Convention Hall of the Hotel Pontchartrain, Detroit, Mich., beginning at 9:30 a. m., Tuesday, May 5, 1914. Mr. J. N. Hatch will preside, and the meeting bids fair to be largely attended. Mr. George W. Kiehm, associate editor of RAILWAY AND LOCOMOTIVE ENGINEERING will prepare a report of the proceedings which will appear in our June issue. The subjects to be discussed were announced in our last month's issue, and the proceedings promise to be of the most interesting kind.

NOTES.

Mr. Alexander Fraser Sinclair.

Mr. Alexander Fraser Sinclair, our Glasgow agent and correspondent, was a surveyor of His Majesty's Customs and Revenue until the end of last year, when he reached the age limit and was retired on a pension. Mr. Sinclair is not the man to hold his hands in idleness because he has been retired from active service. He has for years written a long letter weekly on automobiling for the Glasgow *Herald*. Now he has associated himself with several gentlemen and established what they call the Northern College for the training of men and women to enter the Civil Service. Mr. Sinclair is managing secretary of this institution, and they have commenced the work under very promising auspices.

Removal.

The Chicago branch sales office of The U. S. Light and Heating Co., manufacturers of U-S-L electric starter and lighter, U-S-L storage batteries, and U-S-L axle electric car lighting equipments has been moved from 1013 Peoples Gas Building to 2335 State street. This change brings the U-S-L Chicago sales office and service station into the same building.

The railway department of the Chicago office is now under Mr. H. A. Matthews; Mr. R. E. Stuntz has charge of the battery and starter department, and the service department is being looked after by Mr. H. M. Emerson.

Honorable Retirement.

Mr. William H. Blair and Mr. John Farrell, engineers on the Tyrone division of the Pennsylvania, running between Tyrone and Lock Haven, after long and honorable service, and on account of failing eyesight, have made application for retirement, which will no doubt be granted in the near future. Both are excellent engineers with fine records, and it is hoped that they will long enjoy their well earned retirement.

The Courteous Brakeman.

As the early morning Missouri Pacific train out of Kansas City drew up at a station one morning a pleasant-looking old gentleman stepped out on the platform, and inhaling the fresh air, enthusiastically observed to the brakeman:

"Isn't this invigorating?"

"No, sir," replied the conscientious employee, "it's Pleasant Hill."

Return Ticket.

Little boy, at booking office: "I want a return ticket, please." Booking Clerk: "Where to?" Little Boy: "Why, back here, of course!"

Gasoline Locomotive for the Georgia Coast and Piedmont Railroad

Baldwin gasoline locomotives, built in accordance with patents granted to A. H. Ehle, have now been in service for several years, and have fully demonstrated their efficiency in light industrial and contractors' service. The success of these machines is, unquestionably, largely due to the fact that they follow steam locomotive design where practicable, and embody features which have proved successful in this class of power.

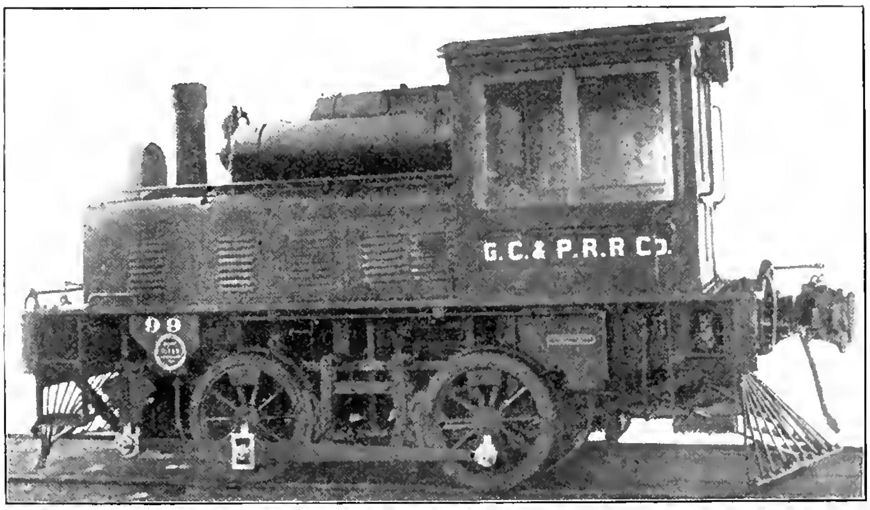
The illustration shows a Baldwin gasoline locomotive recently built for the Georgia Coast & Piedmont R. R. This engine is used in light switching and road service, and was designed for handling a load of 30 tons over grades of 0.5 per cent. and curves of 300 feet radius. In preliminary trials, it handled approximately twice this tonnage. The track gauge is standard, and the locomotive has a nominal speed of 6 miles per hour on low gear and 12 miles per hour on high gear. The hauling capacity given above applies to the latter speed.

This locomotive is propelled by a four-cylinder, four-cycle, water-cooled engine, of 50 horsepower nominal capacity. The power developed by the engine is transmitted to the wheels through a system of shafting, gearing and side rods. This furnishes a positive drive, with large journals and bearings throughout; and all the parts are of ample strength for severe service. The engine and transmission are covered by a hood, on top of which the gasoline tank is placed.

The frames are steel castings, of the familiar bar type. The open construction of these frames facilitates the ventilation of the engine and the inspection of the transmission. This design of frame is very strong, and is also convenient for the suspension of the brake work, and boxes and other fittings.

This locomotive is required to handle trunk line rolling stock, and its equipment has received special attention. Electric head-lights, iron pilots and M. C. B. automatic couplers are provided at each end. Air-brake equipment is applied, air being furnished by a compressor driven from the main engine. The air reservoirs are mounted over the hood. Another important feature is a self-starter for the main engine. This is driven by an electric motor, which receives its current from a storage battery. The latter is automatically charged by a generator driven from the main engine. This battery also furnishes current for the head lights and cab-lights.

The appearance of the locomotive is strongly suggestive of steam practice. The effect is more pronounced because of the position of the muffler, which stands vertically and looks like a smokestack. This device renders the locomotive almost noiseless in operation.



GASOLINE LOCOMOTIVE FOR THE GEORGIA COAST & PIEDMONT R. R.

These machines possess special advantages for light switching and industrial service. They are self-contained, like a steam locomotive; are reliable and simple in operation, and can be easily handled by one man. An advantage which is most apparent in intermittent service is that they consume no power while standing idle. Here the self-starter is particularly effective, as when the locomotive is idle for only short periods of time, the engine can be stopped and started without labor on the part of the operator.

The principal dimensions are as follows:

Wheelbase, 4 ft. 9 ins.
Wheels, diameter, 30 ins.
Journals, 3¼ ins. x 4½ ins.
Width, 6 ft. 6 ins.
Height to top of cab, 8 ft. 6 ins.
Length, 13 ft. 9 ins.
Weight, estimated, 14,000 lbs.

RAILROAD NOTES.

The St. Louis & San Francisco is in the market for 10 locomotives.

The Chicago & North Western, it is said, is in the market for 35 locomotives.

The Norfolk & Western is inquiring for bids on heavy Mallet freight locomotives.

The Southern Pacific is in the market for 5,000 box, stock, flat and gondola cars.

The Central of Georgia has ordered 500 box cars from the Standard Steel Car Co.

The Pennsylvania Railroad has ordered 41 all-steel box cars to be built at its own shops.

The Coal & Coke has ordered two locomotives from the Baldwin Locomotive Works.

The Bangor & Aroostook ordered 125 flat and box cars from the Standard Steel Car Co.

The New York Central Lines will buy 550 automobile cars in the near future, it is said.

The Chicago & North Western has ordered 2,000 refrigerator cars from the Pullman Co.

The Cincinnati, New Orleans & Texas Pacific is in the market for five locomotives, it is reported.

The Atchison, Topeka & Santa Fe will build new shops at Albuquerque, N. M., costing $200,000.

The Illinois Central has ordered 50 Mikado locomotives from the Baldwin Locomotive Works.

The Southern recently ordered 1,500 box cars and 500 flat cars from the American Car & Foundry Co.

The Korean Government Railways have ordered nine locomotives from the American Locomotive Co.

The Minneapolis, St. Paul & St. Ste. Marie has ordered 5,000 tons of rails from the Illinois Steel Co.

The Lackawanna & Wyoming Valley has placed an order for 15 steel hopper cars with the Pressed Steel Car Co.

The Chicago, Burlington & Quincy has placed an order for 1,000 freight cars with the Haskell & Barker Car Company.

The Denver & Rio Grande contemplates extended yardage and eventually large shops southwest of Salt Lake City, Utah.

The Great Northern has ordered 2,000 automobile and box cars from the Haskell & Barker Car Co., according to press reports.

Bids will shortly be taken for 5,000 tons of steel needed for the Broadway-Fourth avenue branch of the Greater New York subways.

The Louisville & Nashville has ordered 18 locomotives built at its Louisville shops. This road is also in the market for 10 locomotives.

The Delaware & Hudson will complete the installation of block signals between Plattsburg and Rouses Point, N. Y., during the present year.

The Intercolonial Railway of Canada has ordered 10 locomotives from the Canadian Locomotive Works and 10 from the Canadian Foundry Co.

The Chesapeake & Ohio is considering building a connecting line from South Portsmouth, Ky., to a point near Columbus, Ohio, in the Hocking Valley.

The Chicago, Milwaukee & St. Paul is in the market for ten coaches, four combination cars, eleven sleeping cars, three observation cars and a dining car.

The Union Pacific has placed an order with the Lima Locomotive Corporation for 54 locomotives. The order includes 25 Pacific type, 15 Mikados and 14 six-wheelers.

The West Virginia Securities and Construction Company is financing a proposed 90-mile railroad that is to connect Parkersburg and Charleston, W. Va. It is to be known as the Charleston, Parkersburg & Northern.

The Central Canada has filed its survey with the Provincial Department of Railways for Alberta. A line is proposed to start from Round Lake on the Edmonton, Dunvegan & British Columbia Ry. to Peace River Crossing.

The Great Northern will expend approximately $500,000 in preparing for the double tracking of its line between St. Paul and Duluth. Work to be done this summer is reported to include reballasting and widening of the grade.

Books, Bulletins, Catalogues, Etc.

The Roll of Honor.

Among the numerous publications in relation to railroads there is an unpretentious little sheet issued by the Pennsylvania Railroad company that deserves more than common notice. It records the monthly addition to the pension roll. Sometimes it is full of brief sketches of the lives of the honored men who have heroically done their life's work, and sometimes there are photographic reproductions of the honest faces that are looking calmly towards the sunset of a life well spent. There is a real nobility about the stories of the earnest workers whose labors are not forgotten, and whose failing vigor has called for sympathetic and kind-hearted consideration. It is a redeeming streak in humanity, and a proof that corporations are not altogether soulless. And yet we can readily imagine that there are many who reluctantly leave their accustomed toil. Sir Walter Scott, the great novelist, when urged by his friends to cease his incessant toil in his declining years, declared that there was one thing certain, that if he ceased working he would assuredly go mad. There is more or less of this spirit in all of us, and it is well to pause and think occasionally in what manner is the evening of our days to be spent "when the wheel is broken at the cistern and the sound of the grinders has become low." This is a question which each man must answer for himself. Certain it is that a pension, well-earned, will sweeten this period, if we ever have such a period.

British Year Book.

The Newcastle and Gateshead Chamber of Commerce has issued a second edition of the Year Book and Commercial Review which is a model of its kind. The chief aim of the work is to give commercial men in other parts of the British Empire, as well as in foreign lands, reliable data regarding the resources of the important locality to which the book chiefly refers, and to emphasize the ability of the manufacturers of all kinds to meet almost any demands made upon them. There is matter of much historical interest regarding the district and the doings of the Chamber during an existence of nearly 100 years, together with able articles on the business carried on in coal mining and shipping, in iron and steel manufacturing, in engineering and other industries. The illustrations are excellent. The book is handsomely printed and bound and sold at sixty cents per copy and may be had from the Locomotive Publishing Co., 3 Amen Corner, Paternoster Row, London, England.

Staybolts.

Ten years ago the Tate Flexible Staybolt was introduced and every year since the increasing number of reports of installation have shown that the original designers of the improvement were correct in their plan of giving a degree of flexibility to the fire box and outer sheets of the boiler so that the varying degrees of expansion could accommodate themselves to the incidental lengthening and shortening inseparable from the action of intense heat on sheets of varied thicknesses and distances from the action of the fire. It must be remembered that the bolt, properly speaking, is not flexible, but the formation of the outer end of the bolt and the socket in which it moves accommodates itself to the flexibility of the sheets, with the result that the tendency to breakage is reduced to a minimum with a corresponding lowering in the price of maintenance. Copies of the company's monthly bulletins, which are an interesting reflex of the work accomplished, may be had by applying to the Flannery Bolt Company, Pittsburgh, Pa.

Consolidated "Axle Light" Equipment.

The Consolidated Railway Electric Lighting & Equipment Company has issued Bulletin No. 11, which presents the story of "Axle Light" in a concise and highly interesting way. The development of the company's system to its present degree of perfection has not been the work of a day. The Consolidated was the first to introduce the single battery system, whereby the number of cells per car was cut in half. This, together with placing the dynamo on the truck end—the outside suspension—instead of the bottom of the car, or inside the truck, completed great steps toward the perfection of the system, which has more recently taken such form as to be readily adapted to all forms of storage batteries. The record of the company's achievements are clearly set forth in the bulletin, and the accompanying illustrations furnished show the complete details of the "Axle Light" equipment. Copies of the bulletin may be had on application to the company's main offices, Nassau and Pine streets, New York.

Hydraulic Jacks.

The Watson-Stillman Company have issued a new catalogue, No. 91, descriptive of their hydraulic jacks and lifting tools, superseding, and surpassing their older publications by a variety of additions to their products. There are about one hundred pages profusely illustrated, and the complete details of all the small parts of the jacks are given accompanied with descriptive matter and price lists.

Of special interest is the section devoted to repair tools for hydraulic tools, and those of us who have wearily wrestled with leaky jacks can readily appreciate what a perfect set of repair tools means to the mechanic who has striven to rend the jack asunder with his bare hands. Complete directions are also furnished in regard to putting in leather packings, so that the average mechanic may readily understand that which was formerly a mystery. The new forms and new purposes to which the jacks may be applied are numberless, and a perusal of the interesting and elegant catalogue is as good as a course in a correspondence school, and copies may be had free on application to the company's main office and works at Aldene, Union County, N. J., or at the New York office, 50 Church street.

The "Chicago Stoper."

The bulletins of the Chicago Pneumatic Tool Company, like the other products of the company, are perfect in their way. Quite a number have been issued this year already, and all of them very interesting. Taking Bulletin No. 154 as an illustration, the description of the "Chicago Stoper" is a model of minuteness. The speed with which the "Stoper" drills in all kinds of rock is described. In examining the details of the appliance it can be readily seen that its marvelous degree of efficiency is largely due to the valve, consisting of a hollow steel ball. It travels less than one-eighth of an inch and its light weight admits of its making a very rapid motion. No matter how high or how low the pressure may be, it moves like a bee's wing, admitting the pressure to the hammer, consisting of a four-pound piece of hardened steel, at the rate of 1,500 uncushioned blows per minute. The rock crumbles into powder under the action of this whirlwind of blows, and there is no waste of air, or of lubrication. The drills are also illustrated and described, and a price list attached. Copies of any of these bulletins may be had from the company's offices, 50 Church street, New York, or Fisher building, Chicago.

Hanomag Journal.

The last number of this interesting journal contains, among other matter, an illustrated description of the 7,000th locomotive built at the Hanover Locomotive Works, Hanover-Linden, Germany. It is a ten-wheel, coupled, superheated, steam freight locomotive, built for the Prussian State Railways, with a six-wheeled tender having a water capacity of 3,650 gallons. The boiler of this engine consists of two cylindrical rings of 5 ft. 3 ins. in diameter, its axis being 8 ft. 10⅜ ins. above the rails. The front and side sheets of the fire box are stiffened by hollow, rolled copper stay bolts. The Schmidt superheater which occupies 24 tubes, each of 4 15/16 ins.-5 3/16 ins., diameter is arranged in four rows. The smoke tubes have been advanced towards the center of the tube plate more than in earlier practice. Experience has shown that this decreases the strain in the tube plate. The engine is also fitted with a feed water heater of a type adopted by the Prussian State Railways, and which is said to give satisfactory results. The engine weighs 69 tons 9 cwt., and the tender, empty, 20 tons 6 cwt. The tractive force is rated at 37,000 lbs.

Graphite.

The Joseph Dixon Crucible Company, N. J., continue to improve the quality of the products for which the company is so justly famous, as well as the intellectual make-up of the monthly periodical devoted to the purpose of establishing a better understanding in regard to the different forms of Graphite and their respective uses. In the most recent number several convincing reasons are lucidly presented showing the durability of Dixon's Silica-Graphite Paint. Among others, a gas holder for the Birmingham railway is an excellent illustration. It is the largest structure of its kind in the South, and calculated to hold three million cubic feet of light, heat and power, and the specification of Dixon's Silica-Graphite Paint for this important holder is in accordance with the maintenance policy of Mr. T. H. R. Daniels, the chief engineer, who is a firm believer in using only material of the highest standard quality. Dixon's graphite publications are sent free on request.

He Deserved It.

The young man was smoking in the non-smoking carriage despite the pained expression on the face of the old lady opposite.

"Young man," she said, speaking between violent fits of coughing, "do you know that it's wrong to smoke?"

"Well," replied the youth, who had often been asked the question before, "I use tobacco for my health."

"Health!" ejaculated the old lady in spluttering tones. "Rubbish! Who ever heard of anything being cured by smoking?"

"Yes, I have," replied the youth, puffing like a traction engine. "That's the way they cure pigs."

"Then smoke away," cried the other bitterly. "There may be hope for you yet."

Life possesses few things more interesting or more revealing than its survivals.

J. BRIERLEY.

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HARRY A. KENNEY,
Gen'l Mgr.

Sworn to and subscribed before me this first day of April, 1914.

OLIVER R. GRANT,
Notary Public No. 1398, *New York County. Commission expires March* 30, 1915.

Railway and Locomotive Engineering

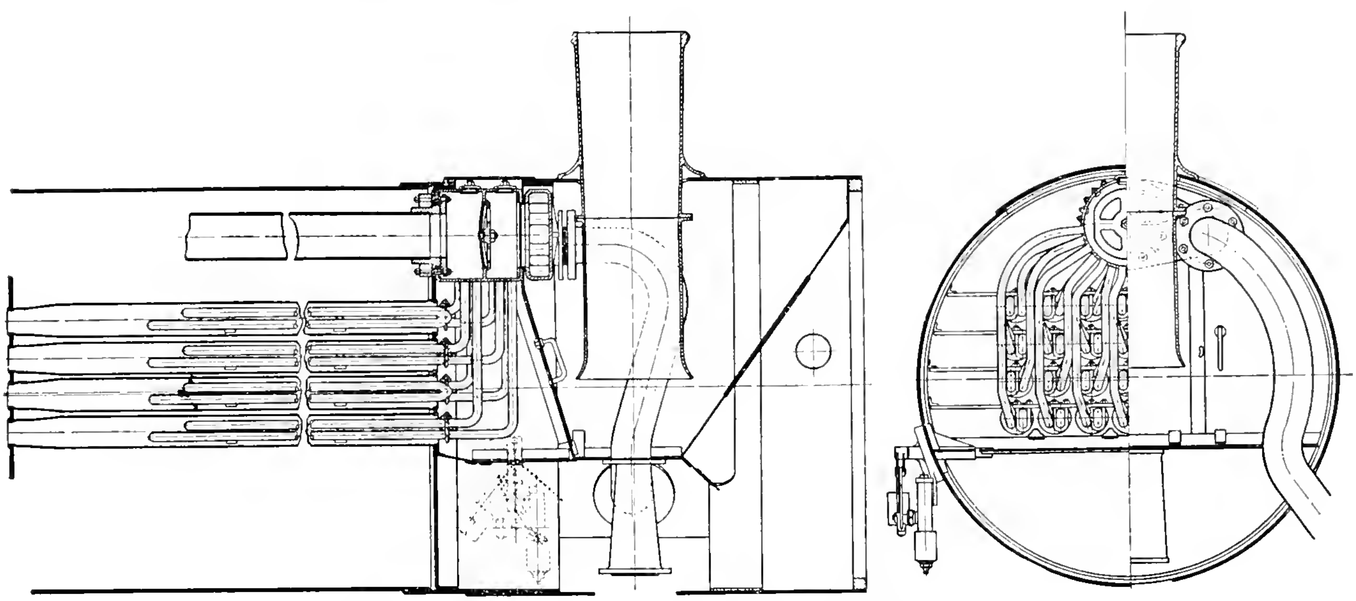
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, June, 1914. No. 6

The Foster Locomotive Superheater

The important gain that has been made in the use of superheated steam in locomotive service has attracted the attention of many clever engineers and inventors to the laudable purpose of improving the appliances used in increasing the temperature of steam and giving it a greater degree of elasticity. It must be admitted that in the first introduction of means towards the desired purpose there were constant complaints in regard to the frequency of failures in the appliances pipes nearest the fire being subject to the greatest degree of heat were a constant source of trouble owing to the rapid deterioration of the castings and their accompanying joints to which the tubes conveying the steam in the process of superheating were attached. The uneven expansion of threaded joints even of the most massive kind are always more or less unreliable when exposed to the action of fire, and hence the expense of maintaining the superheating appliances was failure from cracks. The superheating tubes are expanded into holes in the cylindrical steam header. Hence there is no trouble with ground joints, and in the event of a tube leaking it may be tightened in a few minutes from the outside by simply removing the plate on the top of the smoke box shell, and without disturbing any of the front end equipment.

The arrangement of the superheating elements is such that they may be removed separately or by disturbing only one other

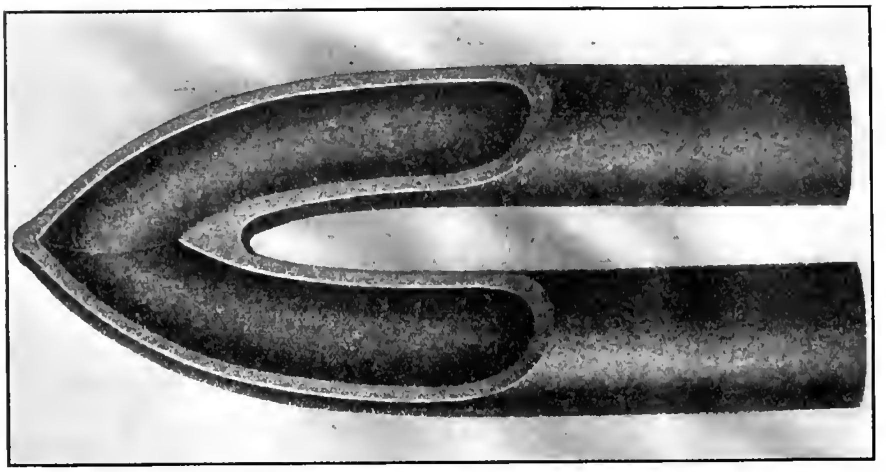


SIDE AND END ELEVATION OF THE FOSTER LOCOMOTIVE SUPERHEATER.

used. This was particularly the case with the numerous joints in connection with the headers where the steam was led from the dry-pipe into the series of pipes reaching through the enlarged flues back toward the firebox, and again when returning to the header attached to the branch pipes leading to the cylinders. The nearness and number of these joints made it a difficult task to keep them all free from leakage. Not only so, but the return joints at the extreme ends of the superheater pipes, or that portion of the one of the early and perhaps the most important drawback to the more rapid adoption of the use of superheated steam in locomotive service.

The Foster locomotive superheater bids fair to have completely overcome these difficulties. As shown in the accompanying illustrations the steam header is cylindrical in form, and differs from other types of headers in material also, being entirely constructed of open hearth boiler steel. As a consequence it is far lighter than the older types and not liable to element. The tubes forming a separate element are held together by electrically welded spacers which present a very small area for obstruction to gases or cinders. The return bends at the extreme ends of the tubes are welded by a special process instead of being formed of a casting into which the lengths of tubes are screwed, as is the case in the older types of return flues. The second illustration shows the detail of the return bend and also shows a section of the tubing cut away so that the welded joint is

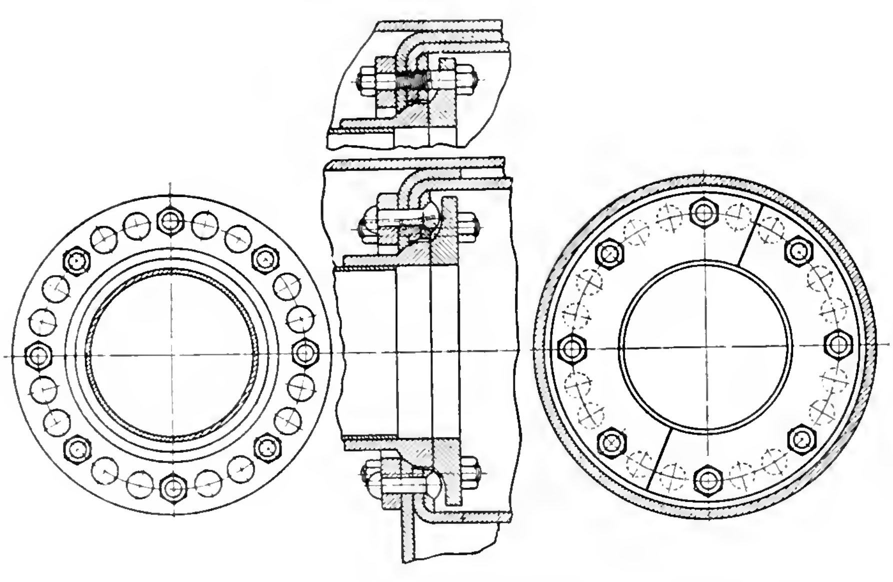
distinctly seen. In the formation of this joint it may be stated that the tube is first bent cold, and then cut at the proper angle and the two parts butted together and welded, making a joint of great strength and durability, thereby completely eliminating any possibility of the leaks which so frequently occur in the case of castings with screwed joints.



DETAIL OF RETURN BEND ON SUPERHEATER PIPES.

The third illustration shows the details of the header and dry-pipe joints. The header is attached to the front flue sheet by rivets and studs that hold securely in the severest kinds of service. Owing to the lightness of the header the strain on the parts are much less than in the case of a heavy casting. The dry-pipe is jointed in the boiler sheet in the usual way, and may be drawn out through the header, which remains in its position riveted to the flue sheet. The header is divided into saturated and superheated steam chambers by a circular partition closed by a diaphragm that is readily removable. In the upper half of the header there are mandrel holes and also two handholes four inches in diameter, all of which are closed by standard Foster superheater plugs. These plugs have been tested in many years' service and admirably suit the purpose of closing the necessary openings in the header. In the lower half of the header the holes for the superheating elements are drilled and into which the element tubes are expanded.

The construction is very substantial and compact. Much space is saved by having the header riveted to the flue sheet and the length of the header extending outwards from the flue sheet is also reduced by locating the tubes in close centres, and expanding the tubes into position instead of using ground joints with complex fastenings. There are also electrically welded supporting lugs attached to the flues. These have a broad bearing surface and cannot cut into the large flues where the lugs rest securely.



DETAILS OF HEADER AND DRY-PIPE JOINTS.

It will thus be seen that the design has the merits of durability, lightness and compactness in an eminent degree. It is also readily adaptable to the various sizes of boilers, and can be made in different sizes to suit the available space in the smoke box. An extension header has been already developed especially for use in the largest locomotives. This, of course, is somewhat more expensive than the cylindrical header, but the larger space admits of a greater degree of convenience in construction and repair and the weight is not greatly added to, as no extra bracing or stays are required. In conclusion it may be said briefly and truly that the design and material used possess the qualities of greater ability to withstand strains due to the sudden and severe variations in temperature; that it is absolutely proof against breakages, while the tendency to leakage is reduced to a minimum, and the facility for repairs, if necessary, are simple and easy.

Clark Firebox Steam Jets.

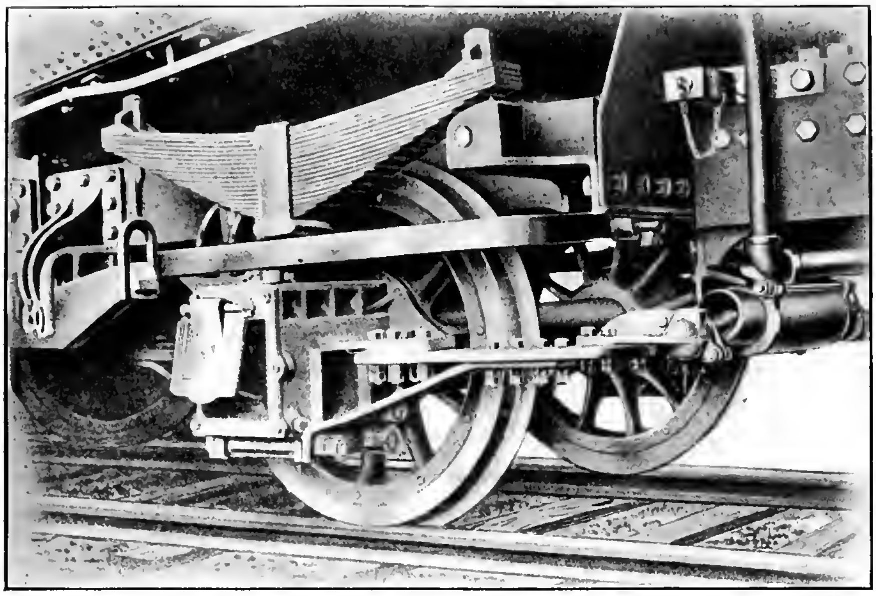
We notice that what was known as the Clark steam jet for locomotive fireboxes has been introduced lately as a new invention. The arrangement was invented in 1857 by D. Kinnear Clark, then locomotive superintendent of the Great North of Scotland as an aid in the prevention of smoke. The invention arranged for a row of holes made through the sides of the firebox, about 12 or 15 inches apart. The holes were about 1½ inch diameter, each one having a small tube in the center through which steam was injected, carrying by induction a current of air. Most of the railway men who used the Clark invention provided means for the regulation of the steam supply and the arrangement was considered a valuable means of smoke prevention, especially when used in connection with a brick arch.

Increased Freight Rates.

The Deutsche Bank of Berlin, one of the great banks of Europe, it its annual report, commenting on the affairs of the financial and commercial world, speaks of the transportation situation in the United States and hits the nail squarely on the head thus: "The American railroads need higher freight rates; their present rates are the lowest in the world—representing, for instance, but a fraction of the English railway rates—and this in face of the fact that wages in the United States on the average are fully twice as high as in Europe. This latter question is one of paramount importance for the economic welfare of the whole country, because the earning power of the gigantic net of American railroads is an essential condition for the possibility of their securing the urgently needed additional capital, whereon in turn depends the prosperity of important industries and the opportunities for the employment of labor."

Outside Bearing Radial Trailing Truck

The accompanying illustrations represents the American Locomotive Company's construction of a radial truck with outside bearings. It has been found to be particularly applicable to the Pacific, Prairie, Mikado and other types of locomotives having two trailing wheels, and more than four coupled driving wheels. It can be readily understood that in such types the long, rigid wheel base requires the use of a truck free to turn about a pivot point, so that when passing round a curve the wheel assumes a position approximately tangent to the curve; otherwise the flange friction against the rails is excessive.



OUTSIDE BEARING RADIAL TRAILING TRUCK.

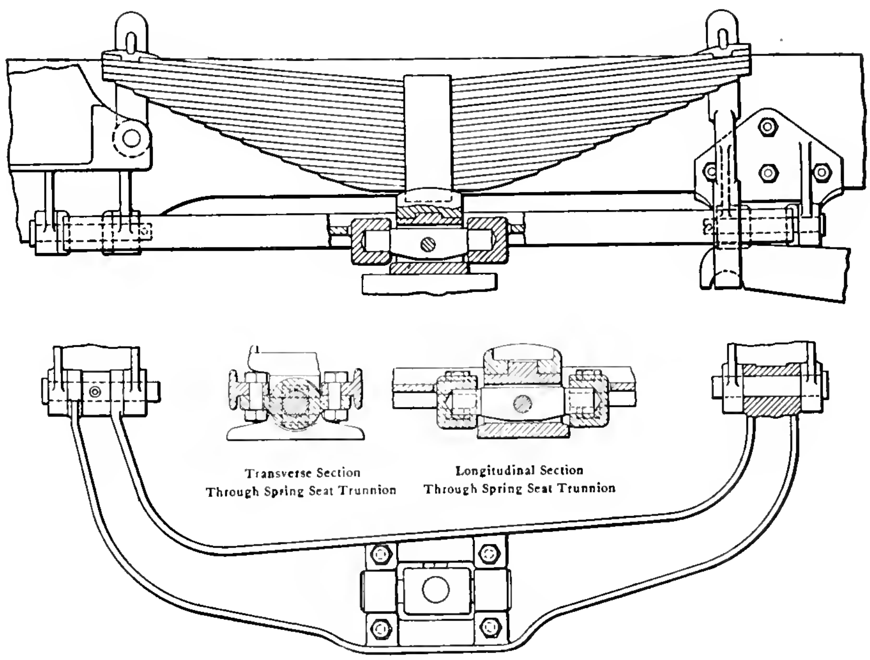
In short, it was owing to this excessive amount of flange wear that the outside bearing radial truck was introduced, and it has admirably met the requirements of the service. By giving a wide supporting base at the rear of the locomotive, the superior riding qualities of the locomotive have been secured.

As will be observed, the journal boxes, which are of cast steel, form a part of the side frames of the truck. The two forward rails or radius arms are inclined inwardly, and are connected together with a steel casting with a hole for the fulcrum pin. Semi-elliptic springs transmit the load to the journal boxes. At the forward ends the springs are connected to the equalizing beams from the rear driving springs in the usual manner and at the other ends to cast steel brackets extending out from the main frames to which they are securely bolted.

The truck springs rest on cast steel spring seats formed of two castings. The upper section is bored out centrally to fit a pivot on the top of the lower section about which it is free to turn. The spring seats fit freely in central openings formed in cast steel floating yokes of I-section giving a strong but light construction. The floating yokes extend inwardly in front and rear of the trailing wheels, and are hinged to lugs secured to the main frames. These floating yokes make it possible to dispense with the outside supplementary trailing frames and the heavy cast steel filling castings forming the attachment between them and the main frames of the engine, which were used in the older type of this class of truck. The construction of the new type is much simpler and lighter, besides a considerable decrease in the overhanging portion of the axle outside of the wheel.

To make the flexibility of the spring bearing on the boxes more readily understood it may be added that the spring supports adjust themselves to the alignment of the journal boxes in any required position without any liability of "cocking" of the spring seats by an arrangement of trunnions, the trunnion blocks passing freely through longitudinal openings in the spring seats, and are provided with pivot ends which are carried in bearings bolted to the under side of the floating yoke. The trunnion blocks are coupled to the spring seats by means of transverse pins passing through the trunnions and spring seats, the whole forming a right angled trunnion or what is generally known as a universal joint connection.

It will thus be seen that with this construction the springs are retained in their normal relation to the main and truck frame in any movement of the journal boxes, either lateral or vertical, relatively to the main frame; and a true bearing of the spring seats on the journal boxes is always maintained. A bevelled friction plate between the spring seats and the top of the boxes is so designed as to assist the action of the spring centering mechanism in resisting the transverse action of the truck and is particularly effective when the locomotive enters a tangent after passing through a curve.



FLOATING SPRING SEAT YOKE AND SPRING SEAT TRUNNION.

General Correspondence

Effect of Wetting Coal.

EDITOR:

The writer was much interested in the article which appeared under the above heading on page 137 RAILWAY AND LOCOMOTIVE ENGINEERING for April.

There seems to be little question of the practice of wetting coal having originated with the blacksmith at the time coal superseded charcoal for smithing purposes, but there is no evidence of the first blacksmiths who used coal having done so to intensify the heat of their fires.

When coal began to be regularly used for smithing purposes, blacksmiths soon discovered that sprinkling the outside of the fire with water not only helped to keep the flame from breaking through but confined the greater part of the heat to the center, where the metal to be forged was heated.

From the original sprinkling of the outside of the forge fire with water, for the purpose already mentioned, the habit of soaking coal in water, previous to using it was developed and like many other customs that have been handed down from past generations, it has been carried beyond all proportion to its usefulness or the purpose for which it was intended.

Common sense and a little study of the laws governing combustion ought to convince the most confirmed coal soakers that the practice of wetting coal to intensify its burning and heating qualities is absolutely wrong, as water in all cases tends to retard instead of promoting combustion and simply amounts to a waste of time and coal energy, as coal that has been soaked in water and used while still wet to build a fire, must be dried out by the heat of whatever dry material which may have been used as kindling, before it can begin to burn; not only this, but in drying out the water, even after combustion is under way, a vapor comes through the fire, that retards heating and has an effect on iron or steel very similar to the effect of cold air coming in contact with them while hot, the result being excessive oxydization. Thus it will be seen that wetting coal where rapid combustion and intense heat are desired is a gross mistake.

By this, the writer does not condemn the use of water for the forge fire, but it ought to be used with a little judgment. For example, in building packed fires such as are generally used for railroad, ship and machine blacksmithing, it is necessary to moisten the coal, just enough to make it sufficiently adhesive to stick together until coking has commenced, but for light work such as horse shoeing, carriage ironing or similar light smithing coal can not be too dry and the only occasion for the use of water is when the coal used is very fine, to moisten it just enough to keep it from finding its way to the center of the fire before it begins to coke or to sprinkle, when the flame begins to break through.

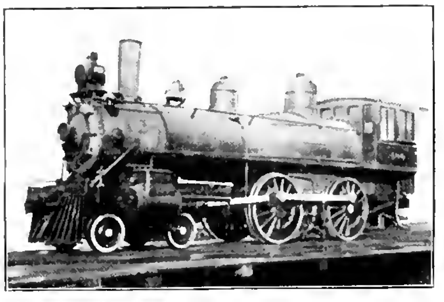
The wetting of coal to intensify the heat of a fire, either in a blacksmith shop or in firing a locomotive, may be summed up as foolishness and can only be practiced by those who are either too ignorant or too lazy to do a little thinking on their own account. JAMES CRAN.

Plainfield, N. J.

Still on the Road.

EDITOR:

Enclosed is a photograph of the last of the lump coal (anthracite) burning locomotives on the Delaware, Lackawanna



LACKAWANNA LUMP COAL BURNER.

& Western Railroad. It was built at Cooke's Locomotive Works in Paterson, N. J., in 1894, and is still doing good service. There is little or no change in the engine except its number, which has been changed several times. Originally it was known as No. 159. The cylinders are 19 inches by 24 inches. Weight 108,000 pounds. Driving wheels, 64 inches in diameter. It is still an excellent engine for the lighter kinds of service and bids fair to see twenty more years on the road.

STEWART GRAHAM.

South Bethlehem, Pa.

Three Cylinder Locomotives.

EDITOR:

In the editorial columns of RAILWAY AND LOCOMOTIVE ENGINEERING last month there are extracts from a paper on Three-Cylinder Locomotives by J. Snowden Bell, in which several misstatements appear.

First, in regard to Webb's three-cylinder engines. The 100 odd passenger engines of this type were built from 1880 (not 1893) to 1899. As most people know, two high pressure cylinders drove the rear pair of drivers and one low pressure the forward driving wheels which were not coupled to the rear pair. The arrangement therefore possessed none of the balancing features or increased uniformity of turning moment which are derived when the relative position of the cranks is fixed and not variable. The engines are hardly an example of three-cylinder construction, since that was a detail and not the main object of the design. All these engines were scrapped as they came in for heavy repairs and none were converted to two-cylinder simples. In this connection it is fair to state that these engines, with the exception of the last batch which were utter failures, did good work when not overloaded. But they lacked flexibility of the simple engines of the same size, so that, with the increasing train loads and their unsuitability to local work, they were useless.

Webb built some 0-8-0 freight engines, with all three cylinders driving on the second coupled axle—two high pressure outside with cranks at 90 degrees and one low pressure inside with crank set at 135 degrees from the other cranks—thus partly balancing the high pressure reciprocating parts and producing a slightly better turning moment than a two-cylinder simple. These have all been converted to two-cylinder simples.

In the next paragraph this statement is made—"In no case has this form of engine established itself as a recognized class for any company." The North Eastern Railway of England received a few years ago a batch of ten 4-4-2 three-cylinder simples, with cylinders 15½ ins. by 26 ins. and cranks, of course, set at 120 degrees. Evidently they proved very successful, for in 1912 another ten—similar to the first, but equipped with superheaters and cylinders 16½ ins. by 26 ins.—were built. These, if I remember correctly, have been illustrated and described in your magazine. Recently a number of 4-4-4 three-cylinder tank engines have been built, doubtless after Mr. Bell's paper was written.

The Midland Railway has a large number of three-cylinder locomotives, in this case compounds, the arrangement being exactly the opposite of Webb's system—two low pressure outside cylinders with cranks set at 90 degrees and one high pressure inside with crank set at 135 degrees from the others. None of these

have been built in the last three or four years because, with the advent of superheating, it was not thought possible to use a superheater on a compound on account of the continued high temperature in the high pressure cylinder, but as this has been done elsewhere, it was decided to try it also on the Midland. The experiment proved perfectly successful, so it is probable that more of these engines will be built.

William G. Landon.

New York, N. Y.

Signal Whistle Disorders.

Editor:

In your article on signal whistle disorders of the May issue I appreciate the fact that the air brake articles are the last word and from the best source. I must take exception, however, to the statement that the signal troubles are caused by the apparatus not being correctly maintained. I realized that the reducing valve must be in perfect condition to get proper results with the communicating whistle when the E. T. equipment was first adopted, and the only trouble we have is of whistle blowing when not desired. A defective signal valve is unknown here. I have not seen a baggy diaphragm for so long that I don't believe they bag or bake any more. That puts the trouble up to the reducing valve in combination with leaks in the signal line. Of course, if the whistle does not blow when a leak is made in the line of proper proportion the whistle is not working as intended. Now to overcome trouble I have had the reducing valves removed and replaced by reducing valves off the test rack and we have the latest improved here every 14 days, and we still have whistle failures. Is it not possible that the 140-pound main reservoir pressure used against the choke in the signal reducing valve as compared with only 45 pounds driving pressure against the choke in the non-return check valve of the E. T. equipment has a good deal to do with the better results we get from the old-style valve. There has been no material change in the signal apparatus for 20 years, while the air brake has been improved so rapidly that it keeps a man stepping to keep up. I remember we thought the quick-action triple valve was as near perfection as a piece of mechanism could be made. They are almost obsolete today. I believe it is up to the manufacturers to give us a better signal arrangement. We can fit a signal valve so that leaks won't bother us on short car trains, but trains are too long for anything like that these days. I would like to hear some more on this subject, and if you want to find out what kind of service you are getting from your signal apparatus start an efficiency test or let it be known that one will be started and the air brake men in the round house will have plenty of work testing pressures and cleaning check valves and reducing valves that will be reported by the engineers.

G. D. Haley.

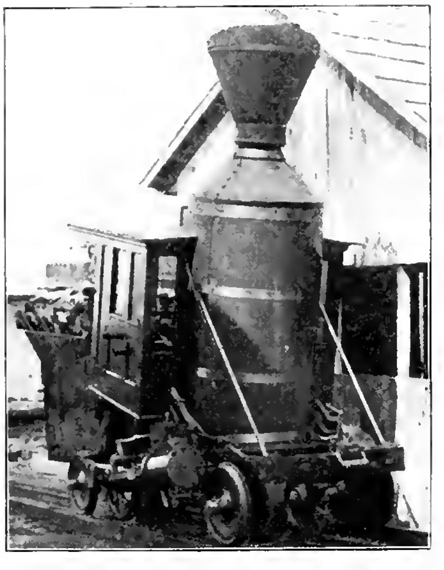
Altoona, Pa.

While our correspondent may have misunderstood the reference to inaccurate repair work in signal apparatus, we must admit that the present train signal system was not designed for trains of from 1200 to 1500 feet in length, and would request him to note in the Air Brake Department the reference to Mr. Armstrong's paper, "The electro-pneumatic signal system," which was read before the meeting of the Air Brake Association.—Ed.

A Rack Rail Old Timer.

Editor:

The accompanying illustration is a sample of the rack rail locomotives that



RACK RAIL LOCOMOTIVE ON THE MOUNT WASHINGTON RAILROAD.

were first used on Mount Washington railroad of Northamptonshire. There were five of these locomotives built by Mr. Walter Aiken, of Franklin, N. H. The names of the engines were: (1) Peppersass, (2) George Stephenson, (3) Hercules, (4) Atlas, (5) Cloud. The angle at which the cab of the locomotive is set in relation to the other parts of the locomotive will give one a good idea of the grade in climbing the mountain. The road was opened about 1870. A story is told of Henry Ward Beecher, who made the ascent of the mountain in one of the trains in the early seventies. A nervous old lady enquired what would become of the passengers if the cog wheels should break and the train should be allowed to slip down the hill as fast as it liked. Beecher quietly replied that it would depend upon the kind of life that the passengers had been living!

No accident ever occurred on the road.

Herbert Fisher.

Taunton, Mass.

The New Haven Bureau of Efficiency.

Editor:

The school of instruction that Mr. Cook wrote about last month is doing excellent work, but the Bureau of Efficiency, another new feature on the New Haven, is also creating a wide interest. An unusual feature of this organization is the interlocking system. At the top there is the Central Committee, composed of General Manager Bardo and his staff. Then there are division committees and a shop committee. On these committees there are representatives of all classes of employees. For example, on a division committee a conductor, a fireman and an engineer sit as fellow members with the division superintendent, the division engineer and the chief train despatcher. They discuss monthly every detail of the operation of the division and every employee is invited to bring in suggestions as to how the service may be made better and defects corrected. The minutes of such a meeting go to the chairman and the members of the Central Committee and to the members of all the other division committees so that every one is kept in touch with what is going on all over the railroad system. Every six months a railroad employee serving as a member of one of these committees must give way to another employee of the same class. Every employee thus ultimately may become a member.

The Bureau of Efficiency is nothing more in effect than a scheme for welding together the railroad organization, scattered, as it perforce must be, in the interest of greater safety for the public and a better service. It seeks to secure the co-operation of every man engaged in the operation of the road, no matter what his job, in attaining these objects. It does not differ essentially from the Safety First organization, adopted now on many roads and in force on the New Haven since last December. In the Bureau of Efficiency questions of discipline are not debated.

W. Richardson.

New Haven, Conn.

Brakes "Creeping on" While Running.

By J. H. Hahn, for Hahn & Burgh, Savannah, Ga.

All air brake men and locomotive engineers who have had any experience with the E. T. No. 6 locomotive brake equipment are more or less familiar with this annoying and troublesome defect of the No. 6 distributing valve. And no doubt many will be relieved by

reading this article, which is written, after many months of study and experimenting, by two practical air brake men. My attention was first called to this defect whenever I made a shift in the train, and, if I happened to be off of my engine when the air was coupled up and air cut in, the driver and tender brake would remain applied, while both automatic and independent brake valves were in running position and pressure equalized, and knowing this would cause trouble sooner or later, I at once began looking for the cause of this trouble.

By attaching a test gauge to the pressure chamber it registered brake pipe pressure, showing that the air was passing over the equalizing piston 26 into the pressure chamber. By measuring equalizing slide valve 31, I found that cavity K would not register with port H, which leads to application cylinder, until the equalizing piston 26 had moved to the left to the full travel of its stroke.

When the air was cut into empty train line, this caused the piston 26 to move to the right, opening the graduating valve 28, and allowing air to flow through ports Z and H to application cylinder from the pressure chamber, as the pressure built up in brake pipe and became greater than the pressure in the pressure chamber, this caused equalizing piston 26 to move back to the left, opening feed groove V supplying the pressure chamber, but did not move far enough to move equalizing slide valve 31 so that cavity K would register with application cylinder port H and release port I, as the feed groove V was open the pressure was balanced on both sides of the piston 26, and as the pressure cannot escape from application cylinder the brakes would stay applied.

Much has been said and written on this matter, and various causes are given for this trouble, and I find that it is caused by only one of the various causes. Whenever the pressure on brake pipe side of piston 26 becomes less than that contained in the pressure chamber, the piston 26 moves to the right, closing feed groove V and moving the slide valve 31, so cavity K does not register with ports H and I. When the pressure is returned slowly in brake pipe, the piston 26 will move back to the left just far enough to let the air into pressure chamber, through feed groove V, but does not move the slide valve far enough so ports H and I will register through cavity K.

By lengthening cavity 5/32 of an inch so that it will register with application cylinder port H and release port I as soon as the piston 26 opens feed groove V, this trouble is entirely eliminated.

When the brakes leak on, it is of no use to release them with the independent brake valve, as they will creep on again. Move the automatic brake valve handle to release position for about two or three seconds, this will cause piston 26 and slide valve 31 to move to release position and the brakes will stay off until for any cause brake pipe pressure drops below the pressure chamber.

You will find that you have much more trouble on long trains of, say, 50 to 100 cars than you do with short trains, also that this gives a great amount of trouble in cold weather on account of the oil becoming cold and stiff.

In actual practice and under all conditions the No. 6 distributing valve works perfect after lengthening cavity K 5/32 of an inch. The tests were made at the Southover shops of the Atlantic Coast Line.

There is an excellent opportunity for our expert correspondents to discuss the question as to whether the lengthening of the exhaust cavity in the equalizing slide value is necessary to improve operation. Is it desirable or is it in any way objectionable?—Ed.

Economy Oil Burner.

By Ray G. Whipple, Victoria, B. C.

Interesting experiments have been made here in regard to securing more economy in the use of oil fuel, with the result that the Economy Oil Burner has been adopted by the Esquimalt & Nanaimo Railway of Vancouver Island, B. C. In a series of tests made on the Canadian Pacific Railway between the Von Borden Inglis Burner and the Von Borden System Economy Burner, an engine running between Coquittan and North Bend, a distance of 112 miles, the following are the records as reported by the railway officials:

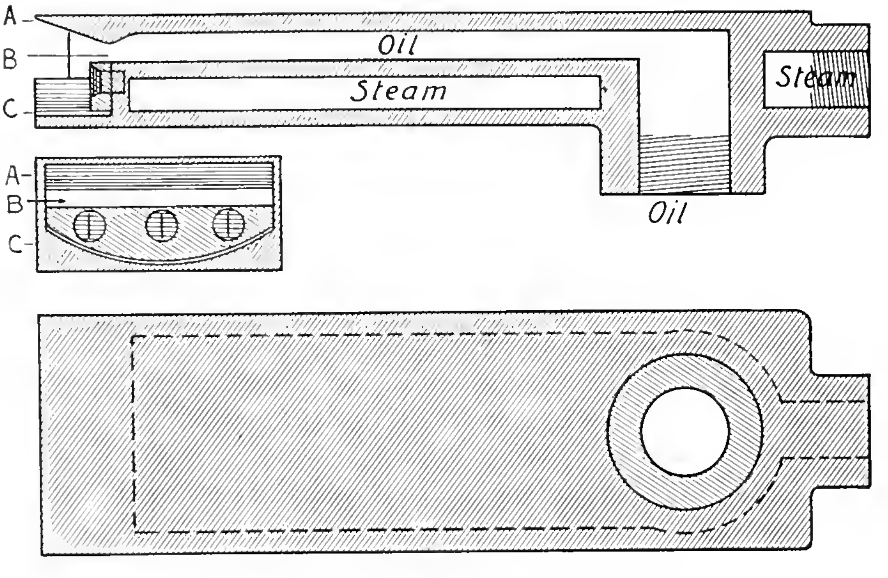
Engine No. 3,401, equipped with Von Borden Inglis System of oil burner, running 112 miles in 6 hours 45 minutes:

Ton miles running	214,243
Gallons of oil consumed	1,740
Gallons of water evaporated per gallon of oil while running	8.8
Gallons of oil consumed per 1,000 ton miles	8.1
Temperature of oil at starting	104°
Temperature of oil at end of trip	102°

Engine No. 3,401, equipped with Von Borden Economy Oil Burner, running 112 miles in 6 hours 47 minutes:

Ton miles running	215,226
Gallons of oil consumed	1,572
Gallons of water evaporated per gallon of oil while running	9.6
Gallons of oil consumed per 1,000 ton miles running	7.3
Temperature of oil at starting	105°
Temperature of oil at end of trip	96°

It will thus be seen that with the use of the improved Economy Burner there is a clear saving of oil of about 11 per cent., and the device, as is shown in the accompanying drawing, is simple in construction and can be manufactured at as little cost as any of the other burners. Its adoption by other railways using oil burning locomotives is a mere question of time, unless some other device can show a better record in point of economy than the above authenticated facts.



DETAILS OF ECONOMY OIL FUEL BURNER.

Co-Operative Education.

By Ralph Rust, Detroit, Mich.

The Wabash Enginemen's School of Instruction was begun at Decatur, Ill., in 1911. It was at first intended to be purely local in its scope, but it was heard of at other points, and the new school was organized last October. In ten days we had 500 members and there are now 1300, being

practically every engineer and fireman on the Wabash system. All felt that we should have the fullest instruction on new equipment in order that we might maintain our positions as engineers and firemen, and be ready to defend ourselves in case of being charged with responsibility for accidents.

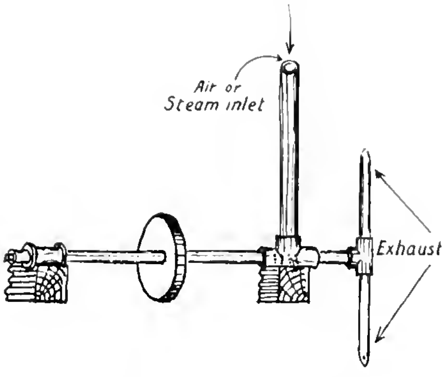


FIG. A. IMPROVISED EMERY WHEEL.

The company furnishes the cars that move from place to place and are fitted up with all the latest devices including all kinds of valve models, brake equipments, electric and other headlights, and steam heat appliances. Our instructors are among the most accomplished in the country, and the cost to the members is, perhaps, the cheapest. Each member pays one dollar entrance fee, and fifty cents per month thereafter. This provides ample means for instructors' salaries, and other expenses, and a gradually increasing surplus.

Each car stops at a terminal from ten to fifteen days and our average attendance at the lectures is two or three times as great as some of the larger systems when the instruction cars are operated wholly by the company. Our system of co-operation awakens a keener interest among the members than any plan hitherto tried.

Improvised Emery Wheel, and Electric Lamp Bracket.

By J. G. Koppel, Electrical Supt. of Bridges, Canadian Pacific Ry., Sault St. Marie, Ontario, Canada.

The attached drawings show, Fig. A, a novel improvised emery wheel connected to a primitive steam or compressed air turbine, which our steam-fitter made from scrap iron for use in a small car repair shanty. There was no other energy available than compressed air, but the simple device admirably suits the purpose of grinding tools and polishing such work as may require to show a finished surface.

Fig. B also shows a drawing of a home-made device—an electric lamp bracket bolted by an adjustable bolt and thumbscrew on the sliding tool holder of a turning lathe. An extension cord is attached long enough to allow the full travel of the length of the lathe. The improved feature is that the electric lamp travels coincidentally with the cutting tool and hence the lamp continues to throw the light right upon the point of operation. If this device has been used before I am not aware of it. In any event the idea may be illuminating to many of the readers of Railway and Locomotive Engineering.

The Passing of the Dandy.

By J. Ring, Leicester, England.

The last horse drawn railway train in England—the "Dandy" which ran regularly according to schedule time between Drumburgh Junction, on the Carlisle and Silloth branch of the North British Railway, and Port Carlisle on the shores of the Solway Firth, about 2½ miles—has been withdrawn, and a steam locomotive and train took its place on April 6 last.

The Dandy afforded much curiosity to tourists and others. It was a tiny four-wheeled vehicle, little more than half the width of an ordinary English railway carriage, and too low for an average person to stand inside with comfort. The luggage was carried on the roof, a relic of stage coach days. Third-class passengers sat outside, placing their feet on the lower foot board, and resting their backs against the body of the carriage. It was drawn by a horse trained to skip over sleepers and crossings with remarkable discernment and judgment. The old coach had been in service for 51 years, and throughout its long history never met with an accident. The North British Railway have presented the quaint old coach to the Port Carlisle Bowls Club to be kept as a relic.

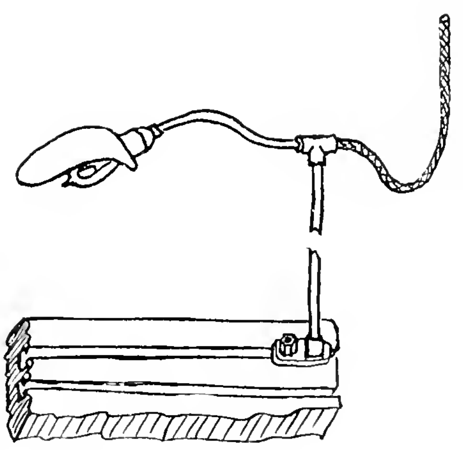


FIG. B. ELECTRIC LAMP BRACKET.

Great things were expected of Port Carlisle in the early years of the nineteenth century, being as its name implies the port of the cathedral city, but it is now a mere village with some pretensions as a resort, quite overshadowed by the port of Silloth, which is nearer the sea.

Revision Upwards.

By G. E. Collingwood, Toledo, Ohio.

The Committee on Transportation of the American Railway Association has undertaken the revision of the Standard Code of Train Rules. From the present indications there will be some sweeping changes made—too sweeping, possibly, for the good of those who are required to operate under them, if the numerous recommendations which have been submitted to the Committee on Transportation are adopted.

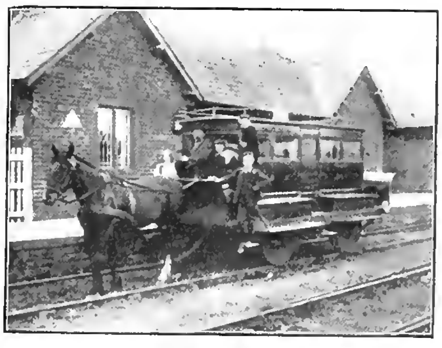
The last revision took place in 1906, at which time many valuable improvements were made in the wording of the rules and train order forms, but only two or three new subjects were taken up and made a part of the rules.

At this time, when the work of revision is in progress, the writer wishes to caution against the error of introducing subjects into the rules which properly belong to the realm of special instructions. The desirable in train rules and orders can be safely supported and can be given sufficient effectiveness under the following three-point suspension system: (1) Correct theory; (2) clearness; (3) brevity.

Up to the present time the Standard Code has been kept reasonably free from matter which is of a more or less local nature, but there is much speculation at the present time as to whether or not the committee, who have the work of revision in hand, will be able to free itself from the mass of recommendations sufficiently to place the revised rules firmly upon the three-point system.

It is a matter of regret that much which has been submitted to the committee, and urged as a necessity, cannot be carried upon the three-point system. For example, it is proposed to add a new rule reading:

"80. Clearance cards (Form A) will be issued by operators upon authority of the dispatcher. They must be without erasure, alteration or interlineation. They may be numbered if desired.


LAST HORSE-DRAWN RAILWAY TRAIN.

"A train may be authorized to use a schedule at its initial station on any division (or subdivision) by a clearance card

(Form A), properly addressed, upon permission from the train dispatcher.

"A train, except a detoured train as provided in Rule 83, must not assume a schedule at an intermediate station unless directed to do so, as prescribed by Forms F or I, nor leave its initial station, or other prescribed stations, on any division (or subdivision) without a clearance card (Form A).

"A detoured train, returning to its own rails, must secure a clearance card before proceeding.

"A train taking siding at an open train order station to be met or passed by another train, must secure a clearance card before proceeding.

"If circuit fails, the clearance card may be issued by the operator, who will endorse on same 'circuit has failed.'"

In the writer's opinion the proposed rule should never be made a part of the Standard Code for the following reasons:

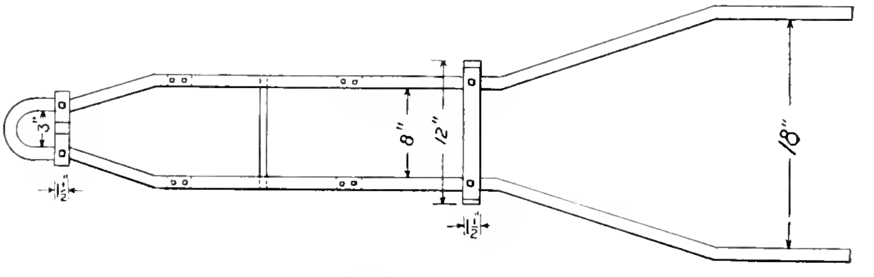
1. The dispatcher will be required to know the necessity of, and given permission for, each clearance card, whether because of signal failure, condition of traffic, or whatsoever may make a clearance card necessary. This will interrupt the dispatcher in the performance of his other duties without adding one iota to the safety of operation.

2. The matter of authorizing a train by the issuing of a clearance card is a purely local contingency. Many roads find the verbal clearance sufficient for protection and for the authorizing of the use of a schedule.

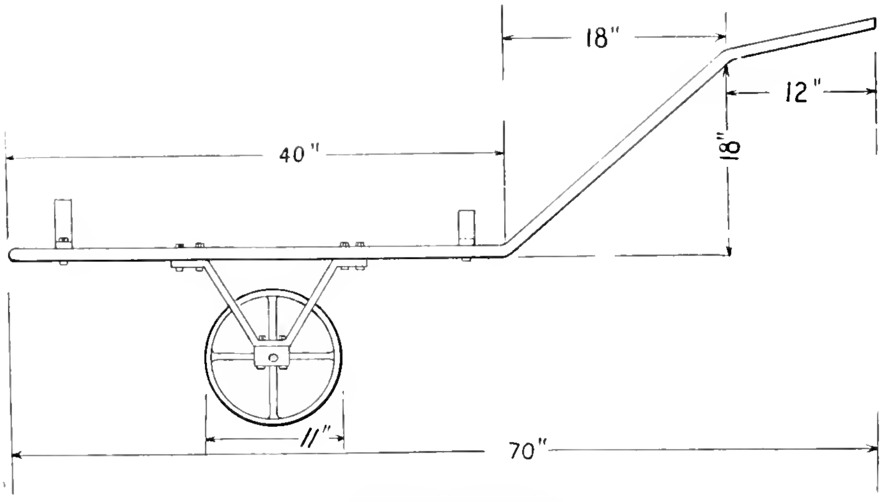
3. The writer objects to the illogical statement in the rule that "A train, except a detoured train, must not assume a schedule at an intermediate station." In the case of a detoured train, it does not "assume," but it does "resume" its schedule. A train which has assumed its schedule at A has a clear title to that schedule to its terminal point on that division or subdivision. Should such train be run extra from B to C, and its schedule annulled between those points, it would have full authority to resume its schedule from C to Z, as such schedule would remain effective between those points and the authority to use it would properly belong to the train which assumed such authority at A. This practice is as safe and as clearly warranted as in the case of a detoured train and therefore should not be discredited by the rule.

4. The requirement that a train taking siding to be met or passed must secure a clearance card before it can proceed is sure to cause much delay which cannot be overcome by the additional "control" thus secured. When the siding is located beyond the station in the direction of movement, it will mean that the conductor will be required, in many cases, to get off at the office and, after securing the clearance card, walk to the head end of the train to deliver the clearance card to the engineman.

Those who recommend this rule claim that the present Standard Code does not give the dispatcher any effective control of the trains which he directs, and that the rule quoted above is desirable for the purpose of giving the dispatcher full control. It does not occur to the writer that the Standard Code, as it stands, is defective in this respect. It is admitted that in a few cases the rule would save the train dispatcher the trouble of arranging with the operator to keep the train under his control for orders, but in many more cases the proposed rule would simply spell out delay to trains, to secure a "control" for which there is no need. From a practical operating standpoint it would seem to be better practice to permit the dispatcher to arrange to hold such trains as he may desire to hold, as is being done at present, allowing other trains which are not wanted for orders, to proceed with the least possible delay.



TOP VIEW OF DRAW-BAR TRUCK.



SIDE VIEW OF DRAW-BAR TRUCK.

Handy Draw Bar Truck.

By F. W. Bentley, Jr., Milwaukee, Wis.

Handling draw bars is something of a hoodoo to many places where anything special for transporting them is not provided. They are an unwieldy object to handle on a truck or any other shop conveyance, and the writer has seen a few accidents as a result of improper loading of the heavy bars as they are wheeled around the shop or roundhouse.

The above sketch is descriptive of a light simple truck which can be easily and cheaply made. It is hard to upset and one man can wheel and handle the heaviest type of bar. The reason for this is that the bars or most of them will balance and the wheel base is wide enough in comparison with the width of the bar to make it hard to upset it on the most uneven shop or roundhouse floor.

The little truck is extremely handy for taking the bars from roundhouse to back shop for closing and annealing, as the bars are easily and quickly loaded and unloaded. One eye of the bar drops over the horn at the end of the truck and the rest of it is held by the U piece at the back. As the affair is made of pipe and other inexpensive material, its manufacture is an easy matter. The writer picked two small pulleys out of the scrap pile in one case for wheels.

For a device that combines the factors of safety and convenience the above is hard to beat.

New Firebox Door.

J. E. Osmer, superintendent of motive power of the Ann Arbor, is the author of a new firebox door which is closed by gravity. When closed the door seals against two inwardly projecting flanges. When open, the door directs the cold air downwardly instead of allowing it to strike straight back against the arch or the flue sheet. It is said to be very effective.

Moguls for the Chicago & Western Indiana

The development of heavy switching locomotives is well exemplified in the ten engines of this type lately built for the Chicago & Western Indiana Railroad Company by the Lima Locomotive Corporation. The designs for these engines were prepared by the locomotive builders according to the specifications submitted by the railway company, and, although they represent nothing radical, they do exemplify the modernization of the heavy switching locomotive.

Our illustration shows the 2-6-0 type, generally known as the Mogul type of locomotive. They are quite similar to those previously furnished to the Chicago & Western Indiana Railroad Company by other builders, but they have been improved along the lines of service experience with the earlier ones. The journals have been made larger than the previous engines and improvements have been made to the side rod and guide yoke to facilitate taking down the front section of these rods. Strictly speaking, the engines are for interchangeable service and not for switching service exclusively. The Chicago & Western Indiana operates a limited suburban schedule, and the Mogul engines are used in passenger service as well as in freight traffic and switching operations. They are equipped with a peculiar design of stub pilot, which has been developed by this railway company, and which embodies the conditions necessary on a pilot for road service, and also the conditions necessary for a switching step. They are equipped with brick arch and superheaters and are therefore fully modernized in fuel saving devices. The steam is delivered through outside steam pipes and the piston valves are operated by Baker gear. Markel main rod ends are used. They are possibly the heaviest Mogul locomotives now in service and represent an ideal engine for short runs in interchangeable service and for operation on sharp curves and various conditions of the track.

The tenders of these engines are of special design arranged with the fuel collar set in at the edge of the water leg to allow unobstructed view by the engine man. This arrangement was suggested by the railroad company in accordance with their experience with other tenders of the same capacity which had high coal boards, and which were ill-adapted for the service conditions on this account. The suggested improvement was worked out by Lima Locomotive Corporation and resulted in a handsome tender of rather unique appearance.

The general dimensions of these engines are as follows:

Gauge, 4 ft. 8½ ins.

Cylinders, 23 ins. by 28 ins.

Valves — Piston, diameter, 14 ins.; maximum travel, 6½ ins.; steam lap, 1 in.; exhaust clearance, 1/16 in.; lead, constant, ¼ in.; motion, Baker.

Boiler—Straight top; staying, radial; working pressure, 180 pounds; outside diameter, first ring, 76¾ ins.

Firebox—Length, 108 ins.; width, 69¼ ins.; thickness of sheets, ⅜ in. and ½ in.; water space, 4½ ins. and 4 ins.

Tubes—Material, steel, No. 201; diameter, outside, 2 ins.; thickness of tubes, No. 11, B. W. G.; large flues, No. 32, outside diameter, 5⅜ ins.; thickness of large flues, No. 9, B. W. G.; length of flues, 13 ft. 7 ins.

Heating Surface—Firebox, 185 sq. ft.; tubes and flues, 2,028 sq. ft.; total, 2,213 sq. ft.; superheating surface, 540 sq. ft.; grate area, 52 sq. ft.

Driving Wheels—Diameter, outside, 63 ins.; thickness of tires, 3½ ins.; journals, 11 ins. by 13 ins.; truck wheels, diameter, 33 ins.; truck journals, 6½ ins. by 12 ins.

Tender—Frame, 10 ins. by 13 ins. channels; wheels, diameter, 33 ins.; material, rolled steel; journals, 5½ ins. by 10 ins.; water capacity, 7,750 gals.; coal capacity, 8 tons.

Weight—On drivers, 165,200 pounds; on leading truck, 29,400 pounds; total, 194,600. Total weight of engine and tender in working order, 335,600 pounds.

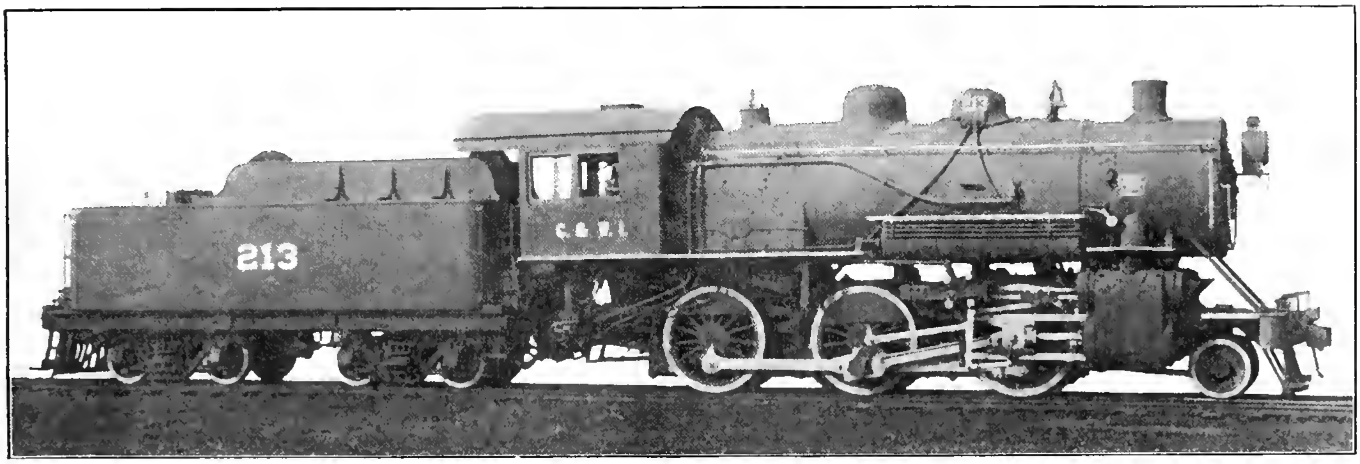
Wheel Base—Driving, 15 ft.; total wheel base, 24 ft. 1 in.; wheel base engine and tender, 56 ft. 10¾ ins.

Service—Mixed.

Fuel—Bituminous coal.

Superheater—Schmidt, number of units, 32.

Ratio of adhesion, 4.6.



MOGUL, 2-6-0, TYPE OF LOCOMOTIVES FOR THE CHICAGO & WESTERN INDIANA RAILROAD.

Level Crossing Signals.

The Lehigh Valley Railroad is making strenuous efforts to promote safety by reducing the number of acc dents at highway level crossings. A conspicuous source of danger at highway crossings has been banks, brush and buildings that obstruct the view of approaching trains. These have been removed everywhere that the change was practicable and an excellent system of signaling has been introduced to give warning of the approach of trains. As soon as a train comes within a mile of a crossing a signal shows a red light and a loud sounding gong begins to ring. Both warnings are kept in operation until the train has passed.

Coal Supply.

As the consumption of anthracite coal is greater in the United States than in any other country, the belief is widespread that the United States contains greater anthracite deposits than other countries. That is a great mistake. Geologists estimate that the United States holds about 19,700 million tons of that valuable fuel. China contains 387,500 million tons. China is also very rich in bituminous coal deposits, but not so rich as the United States. It may come to pass, however, that China will provide the source of heating for the rest of the world.

General Foremen's Department

Annual Convention.

The annual convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, July 14-17. Mr. Wm. Hall, secretary-treasurer, 829 West Broadway, Winona, Minn.

Influence of Apprentice Schools.

The writer, who has a supervision of the apprentice school connected with the repair shops of the Erie Railroad, is convinced that the technical instruction to the apprentices connected with numerous railroad repair shops and manufacturing establishments is more useful for promoting the life prospects of workmen than any line of education they could receive. Considerably less than ten per cent. of our population secures an education beyond that of the elementary schools, other than that which results from the accident of their later environment.

The work of the apprentice schools is practically a continuation school in industry, endeavoring through specialized training to redeem the shortcomings of the original education. The technical education which they receive prepares them to perform the duties of mechanical officials and in that respect is beneficial alike to the apprentices and to the concerns employing them.

Where these schools have been in operation the results have been on the whole eminently satisfactory, although occasionally an individual is encountered who fails to appreciate the opportunities put within his reach. Not only is the intellectual average of the employe considerably raised, meaning a lessened degree of industrial unrest, and a higher degree of individual and general efficiency, but those coming under the influence of the school training become citizens of improved social standing.

Laying Out Shoes and Wedges.

By R. C. McIntosh, Shop Foreman, Rutland Railroad, Rutland, Vt.

I have been greatly interested in the articles on "Shoes and Wedges" in the March and April issues of your paper. Too much care cannot be taken with this job, as it is the foundation of the engine and after the wheels are once in place it is hard to correct an error, and more so when the engine has underhung spring rigging.

As Mr. Chamberlin states in the March number, most shops have their own way of doing work and think their method is the best. I have seen both, the method described by Mr. Chamberlin in the March issue and the one described by Mr. Vestal in the April issue, used with good results. The method described by Mr. Chamberlin is very accurate but slow. The one described by Mr. Vestal is quicker and you have all your shoes and wedges to be planed at one time, but great care must be used in this method. In getting your square line, either method will answer the purpose. The fish tail tram is much the quickest. I have worked in two different shops on the same system using different methods. In using the fish tail tram, a board can be placed between the frames and centered, and this center used in place of center of cylinder casting.

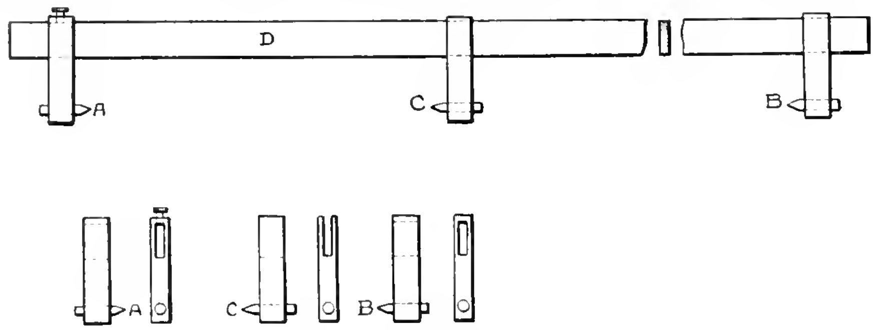


FIG. 1. TRANSFER GAUGE.

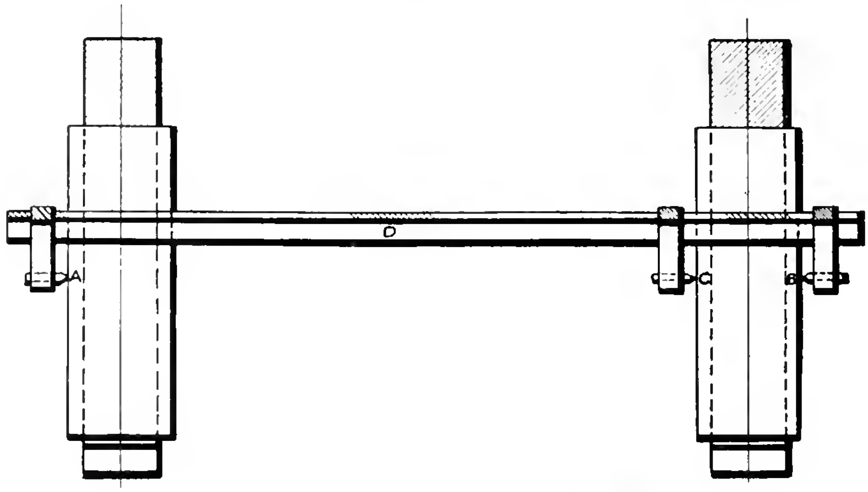


FIG. 2. APPLICATION OF TRANSFER GAUGE.

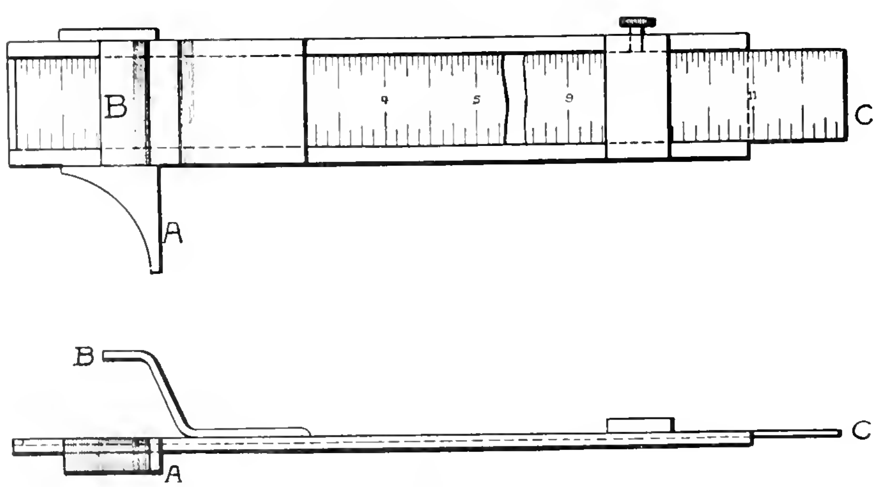


FIG. 3. WEDGE GAUGE.

The tram shown in Fig. 3 of Mr. Vestal's article is a true and convenient method of transferring your points to inside of shoe and wedge, but I can't see how it can be used on engines where fire box rests directly on frame. I am enclosing you sketch of a transfer gauge that I think is a good one, also its application. In using this gauge it is necessary that the boxes be planed in pairs and bored central; that is, the right and left boxes of each pair of wheels must be planed the same size and bored central.

In the sketch, Fig. 1, "D" is a straight edge long enough to reach across the frames and extend a few inches beyond. The centers "A," "B" and "C" must be equal distances from straight edge. The block holding point "B" is fixed firmly on the straight edge, while the one holding point "A" is adjustable and can be moved along the straight edge and can be fixed at any point by the set screw at the top. The block that holds point "C" is slotted at the top, as shown, so it can be removed and the center punch placed so it faces either "A" or "B" and the block can be slipped along the straight edge to any position.

Now, having the shoes and wedges laid off as shown in Mr. Vestal's method, it is desired to transfer a point to the inner side of shoe and wedge to enable the planer man to set up the work. Using the lettering in Fig. 4 of Mr. Vestal's article, take a point midway between "X" and "Y" and center punch it. Now do this on opposite jaw, being sure to use equal distances from top of frame. Now place point "A" in one of these center punch marks and point "B" in other and your straight edge is set as shown in Sketch 2. Now you can move point "C" up against the shoe of either right or left jaw and hit the center punch with light hammer. Now repeat on inside face of other shoe. Repeat this operation on all shoes and wedges and they are ready for planer.

In the method explained by Mr. Chamberlin the shoes are laid off first and planed and then replaced and wedge laid off from them. We have a gauge in this shop that I think is the quickest and most accurate of any that I have yet seen. It was designed some years ago by Mr. James Hurley, of the Rutland shops, and has been used here ever since and I have yet to see an error made while using it. It can be used the same as gauge shown in Fig. 8 of Mr. Chamberlin's article and answers the same purpose, but with this gauge it is unnecessary to use calipers or a scale. The gauge is shown in Fig. 3 and its application in Sketches 1 and 2 of sketch entitled "Application of Gauges." The distance from "A" to "B" in Fig. 3 is equal to the distance from the face of shoe to the witness mark, or, in other words, the snap gauge distance. Now, in getting box size box, of course, to be bored central—place surface "A" against shoe face of box and extend "C" out until it just reaches wedge face of box. Now tighten your thumb screw and gauge is set. This operation is shown in Fig. 2 of the sketch entitled "Application of Gauges." Now place surface "B" against face of shoe and let point "C" rest on wedge. Now scribe a line where point "C" touches wedge and you have your box size plus the witness mark or snap gauge distance, as the distance from "A" to "B," as stated before, is your snap gauge distance.

Am also enclosing you sketches of center gauges used in this shop. Fig. 1 of the sketch is to be used on old boxes that are to be bored back on the crown brass. It is made of a piece of 1-in. angle drawn out and turned over as shown. The face "B" can be moved around the wearing surface of the brass and point "A" will scribe a circle on hub face of box. Now this line can be tried with shoe and wedge face of box. It can also be used to check up the work of boring mill man.

Fig. 2 of this sketch is a gauge to use on boxes that have already been applied to journals. Surface "B" is placed against shoe or wedge face of box and point "A" is screwed in until it touches journal. Now try it on other side of box and you can tell if your box is central.

Many times the shoe and wedge job is blamed for the wearing of sharp flanges on the drivers when the lead truck is to be blamed. Great care should be taken that the center casting is directly between the frames.

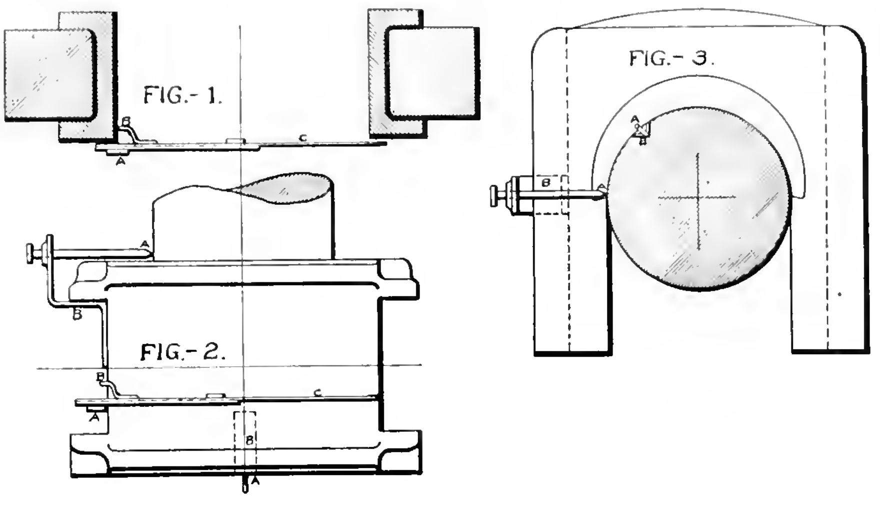


FIG. 4. APPLICATION OF GAUGES.

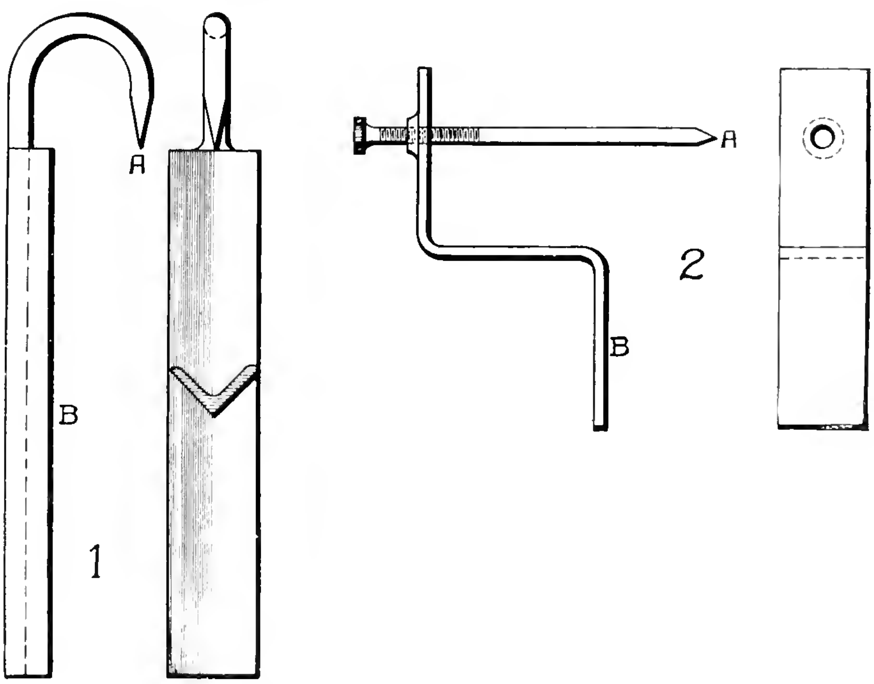


FIG. 5. CENTER GAUGES.

Catechism of Railroad Operation

NEW SERIES.

Beginning Third Year's Examination.

(*Continued from page 184, May, 1914.*)

Q. 1.—What are the duties of an engineer on being called, preparatory to attaching to train? A.—He should report at the roundhouse on time required by rules, or earlier if possible. Inspect the bulletins and sign for those requiring acknowledgment. Compare his watch with standard time and register result in seconds slow or fast, or O. K. Find out the number of engine he takes out and register out. Examine work report for work reported and work done at that point while engine was in. Go to engine, inspect condition of crown sheet and firebox and flues and note condition of fire. Try gauge cocks to ascertain water level and compare water glass with the try cocks, blowing out the water glass and trying stop cocks in upper and lower mountings to know that they are free and will close properly when needed, then open each stop cock the same to insure a perfect equalization and a true water level indicated in the glass. Try both injectors and know that they are O. K. See that you have the necessary supplies of coal, water, sand, firing and hand tools and other tools and extras required, signal lamps and flags and safety devices. Fill lubricator, start air-pump working slowly with drain cocks open, inspect engine and tender thoroughly, starting at a given point and examining ash pans and all parts underneath engine and tender and connections between engine and tender as well as all parts outside, noting especially that parts having work done on them are properly replaced, adjusted and secured with split-keys when necessary. Examine head-light and tail-light to know they are in perfect condition, and finish inspection at starting point where it began.

Climb up on engine and increase speed of air pump, take engine oiler and oil around, furnishing lubrication to all parts requiring it, adjust oil feeders in cups having feeders, open angle cocks to train and signal lines at pilot and rear of tender to free them of cinders, dirt and moisture. Separate hose connections between engine and tender for same purpose.

When proper air pressures are accumulated try automatic brakes, noting piston travel and whether they apply properly and hold on at least three minutes, then try the independent or straight air brake in same manner and note whether the brakes release in proper manner, being sure that brakes are operative on both engine and tender and piston travel properly adjusted. Try the air sander device to be sure that sand flows freely on both sides. Try the other devices operated by compressed air such as bell-ringer, fire-doors, etc., to know they work right, start cylinder feeds to lubricate about ten minutes before attaching engine to train.

Note.—It takes a drop of oil about seven minutes to reach steam chest after it leaves sight feed glass.

Q. 2.—What tools and supplies do you require starting on trip? A.—Name the necessary hand and firing tools, classification lamps, hand lamps, markers, flags and so forth, that your rules prescribe, being sure to name coal, oil, water, sand, extra brasses, head-light wick and chimney or carbons (depending on kind of light in use), water glass and gaskets, lubricator glasses and gaskets, colored plates for markers, replacers, cable chain, pinch bar, sledge hammer or maul and all such necessary appliances as the rules pertaining to road requirements may call for as a complete complement for service.

Note.—The higher officials of different roads determine the necessary complement of tools and safety devices required to meet conditions obtaining on that system or part of system and issue rules relative to the kind and number of each needed to promote safety and facilitate movement of trains.

Enginemen are responsible for having the proper equipment leaving terminals.

Q. 3.—Should an engine break down while on the road in your care, what are your first duties? A.—*Whistle out the flag*, and see that the train is protected at once.

Q. 4.—What are your next duties? A.—Clear the main line as soon as possible and report exact conditions to the proper officials (the master mechanic and superintendent).

Note.—"Clearing the main line" means ascertaining extent of damages and making such temporary repairs as will enable you to get on siding out of way of other trains, after which more extensive repairs can be made as the occasion may require to enable you to proceed safely to terminal.

Q. 5.—Do the gauge cocks indicate the true water level in boiler as accurately as the water glass? Why? A.—No, the gauge cocks are not as reliable as a perfect working water glass, because boiling water will rise the moment the pressure is relieved even a little, therefore when the gauge cock is opened it relieves the pressure on water below it and the globes of steam in water begin to burst beneath the surface of water and throw it up to opening in gauge cock, many times showing water at a gauge cock an inch or two above the true water level, while the water glass having the pressures perfectly equalized in it the same as they are in boiler the water in glass is at exactly the same level as it is in boiler.

Q. 6.—Is the water glass safe to depend on for water level in boiler if water does not move up and down in it when engine is in motion? Why? A.—No. If the water does not oscillate in glass when engine is in motion, one of the stop cocks in mountings is partially closed or the opening leading from boiler is stopped up with corrosion or piece of gasket so the pressures are not equalized and water in glass does not respond to movements of water in the boiler, consequently it does not show the true water level and is not reliable.

Q. 7.—How should all water and steam valves and cocks be handled at all times to prevent them becoming defective? A.—They should be opened and closed gently, using only the pressure of the hand in manipulating them.

Note.—A wrench or any other force used causes serious damage to seats and is liable to break the body of fitting off where it enters boiler, resulting in personal injury.

Q. 8.—How do you inspect an engine? A.—Thoroughly. Beginning in the cab, inspect all fittings and appliances there, examining the firebox sheets and tubes, then get down and inspect connections and parts between engine and tender; going ahead examine all parts of frame, ash pan, wheels, boxes, valve gear, spring rigging, bolts, nuts, rods, keys, levers, etc.; passing around front end of engine, noting conditions there, work back to rear of tender, thoroughly inspecting every part; passing around back of tender, finish the inspection at place where you started, having noted every defective part.

Q. 9.—What work on the engine should be done by the engineman? A.—Setting up wedges, keying rods, tightening nuts if necessary, adjusting oil cup feeds, securing pipe clamps, adjusting brake shoes that may have become loose by wearing, tightening valve stem packing and any other necessary work while on the road to insure a successful trip and avoid engine failures.

Elements of Physical Science

By JAMES KENNEDY

XII. Centre of Gravity.

The centre of gravity is a point in any body about which all its parts are balanced. It is the centre of weight and must be distinguished from the centre of magnitude or of motion. The centre of magnitude is a point equally distant from its opposite sides. The centre of motion in a revolving body is a point which remains at rest, while all the other points of the surface are in motion. The centre of gravity may coincide with the centre of magnitude and it may not. If a wheel is of uniform weight and density the centres of magnitude and of gravity will be the same, but if the wheel is heavier on one part, the centres will vary in a corresponding ratio.

The point in a body in which the centre of gravity is situated, may be found, in many cases, by balancing it on a point. In bodies of regular shape and density lines drawn from opposite corners will bisect each other at the centre of gravity. Bodies that are irregular in shape and that may be suspended so that they can move freely, may have the centre of gravity located by dropping a plumb line from the point of suspension, and mark the direction of the line on the surface of the body. The body can then be moved to another position and another line drawn where the plumb line is applied, as before. The bisecting point will be the centre of gravity.

XIII. Stability of Bodies.

The lowest side of any body is called the base. When the line of direction passing through the centre of gravity falls within the base, a body stands; when the line passes outside the base, the body falls. Of different bodies of the same height, that which has the broadest base is the hardest to overturn, because its line of direction must be moved the furthest to fall outside of its base. The truth of this principle has its enduring proof in the stability of the pyramids. No other structures fastened by human hands have stood the blows of circumstance for so long a time.

A ball of uniform density has its centre of gravity at its centre of magnitude. When such a ball rests on a level surface, the line of direction passes through the point of support and the ball remains stationary. When a ball is placed on a sloping surface, the line of direction falls outside of the base, and the ball begins to roll. A square block placed on the same surface maintains its position because the centre of gravity falls within the base. Of bodies with bases equally large the lowest is the hardest to overturn, because its line of direction is least liable to fall outside of its base. Under these conditions, the lower the centre of gravity, the more stable a body is. It will be observed that in packing goods in wagons or cars or vessels, the heaviest are placed lowest.

It may be noted that while there are no exceptions to the general law relating to bodies falling, where the line of direction of the centre of gravity falls outside of the base, some bodies can be so constructed as to resist the force of gravity. The most notable illustration of this remarkable fact is that of the leaning tower of Pisa in Italy, which with a height of 183 feet, and leaning to such a degree that the top of the tower overhangs its base over 13 feet. In spite of this fact it has stood for many centuries. The centre of gravity however is much nearer the centre of the building than might be supposed, and there is no reason to suppose that the architects, Bonano and William of Innsbruck, intended that the tower should be built in this oblique position, every indication being that the structure assumed this position while the work was still in progress. The clever architects however overcame the threatening attitude of the building, for while the walls of the base are 13 feet thick of fine marble and heavy volcanic rock, the middle stories are of brick, and the upper stories mostly of an exceedingly light porous stone. If the exact ratio of weight and material had been used throughout the building could not have stood. As it is the singular attitude of the building detracts much from the rare nobility of the structure, which is generally admitted to be the very noblest of the Romanesque style of architecture.

XIV. Rotary Motion.

Rotary motion has the peculiar quality of keeping a body from falling, even when its line of direction falls outside of its base. This will readily be observed in the spinning of tops, which retain their equilibrium while in motion, but which fall immediately on becoming stationary. Other bodies not so evenly balanced can readily be kept from falling even if the centre of gravity is still over the point of support, but if the body is constantly moving round the axis of motion, before it has time to fall in consequence of being on one side of its axis, it reaches the other side, and thus counteracting the previous impulse retains its equilibrium. The higher speed has the effect of steadying more completely the moving body, by the sheer force of the acquired momentum much more than overcoming the tendency to fall by the force of gravity, but as the velocity slackens and the force of momentum weakens, the moving body gradually oscillates more and more, and finally falls.

XV. Equilibrium.

The centre of gravity in all bodies tends to get to the lowest possible point. Solid bodies resting on a surface in such a way that their centres of gravity are lower than they would be in any other position, are said to be in a stable equilibrium. If the centre of gravity could be brought lower, by placing them differently, they are said to be in unstable equilibrium. Thus an oval resting upon its longest side would be in stable equilibrium; while standing on one end it would be said to be in unstable equilibrium.

Huge Locomotives and Great Steamships.

The Erie's latest Triplex compound locomotive indicates that increase in the capacity of railroad motive power has not reached the end, and it seems that all vessels used for transportation purposes keep increasing in size.

The desire to introduce very large steamships was manifested long ago and was brought to a severe test as long ago as 1852, when Sir I. K. Brunel designed and superintended the building of the *Great Eastern*, which was long the largest vessel afloat and the greatest failure financially. The *Great Eastern* steamship was 680 feet long; 83 foot beam; mean draft 25 feet; indicated horse power 4,000. The *Great Eastern* was one of the finest looking vessels ever launched, but the fatal mistake from a business standpoint was made of supplying her with too little power.

The *Vaterland* is 950 feet long. The newer boat will come close to 1,000 feet. In a little while, judging from the changes which have been witnessed in recent years, there will be Atlantic steamships fully 1,000 feet long, more than 100 feet wide and correspondingly deep. They will measure 70,000 or 75,000 tons and displace probably 80,000 or 85,000 tons.

But they will still roll and plunge in great ocean storms. They will still have extreme need of caution in the vicinity of icebergs. The biggest of them are helpless when they go upon the ground and they sink when they strike a rock or an iceberg. What is more needed than size is means to keep the vessels afloat when accident tears a hole in the outside shell.

Questions Answered

VARIABLE SPEEDS OF TRAINS.

G. A. Ellis, San Francisco, Cal., writes: Last month an examination was held here by the United States Civil Service for the position of Inspector of Safety Appliances, and among other questions was the following: A train leaves Chicago running 18 miles an hour. After being on the road 9½ hours, another train leaves Chicago running 45 miles an hour, which overtakes the first train passing it at "P." How far from Chicago is the point "P"? Now, what we desire here is to get the rule by which the problem can be worked out without going into algebra. I have been requested to ask RAILWAY AND LOCOMOTIVE ENGINEERING for the proper solution of this problem in common figures. A.—Suppose that the first train after running 171 miles in 18 hours, instead of continuing the journey, stands still, and the second train, instead of running at 45 miles an hour, runs at 18 miles less than 45, which is 27 miles; then 171 divided by 27 would be 6⅓ hours, and if the second train runs at 45 miles an hour for 6⅓ hours it will have run 285 miles the distance when the two trains will come together when running at the speeds proposed, because 9½ hours added to 6⅓ hours is 15 5/6 hours, which, at 18 miles an hour, amounts also to 285 miles, the point when the second train overtakes the first train. Or in simple figures: $45 - 18 = 27$, and $171 \div 27 = 6\frac{1}{3} \times 45 = 285$ miles, and $9\frac{1}{2} + 6\frac{1}{3} = 15\,5/6 \times 18 = 285$ miles.

METALLIC PACKING.

B. A., East Tawas, Mich., writes:—What is the formula generally used in railroad operation for metallic valve stem and piston rod packing?—A. The original United States Metallic Packing Company's formula was: Tin 100 parts, copper 9, antimony 6; total 115 parts. These three metals stood in the proportion of 87 per cent., 7¾ per cent. and 5¼ per cent., respectively. If the alloy so made is too hard for some conditions, a reduction of the antimony to 3 parts instead of 6, with the tin and copper as specified gives very good results. Many roads use special alloys, the result of much experiment.

WHEEL FLANGES AND SIGNAL WHISTLES.

J. R. G., Baltimore, Md., asks:—(1) If the drivers are not properly lined up so that the axles are not square to a center line drawn through the cylinders, why do the drivers on the side farthest ahead cut their flanges? (2) What other visible effects result from this distortion? (3) I understand that the present signal valve as applied to locomotives is not reliable for long trains. Have any air brake manufacturers made an effort to construct a valve that will give any number of distinct blasts that will be heard on any length of train?—A. (1) Some other cause must be looked for in the case of wheel flanges cutting more on the one side than the other besides the axles being out of square, in which case the flanges would be both equally subject to undue pressure. Very often the leading truck is the cause of flange cutting. Occasional errors are also found in the dimensions of driving boxes. (2) The axles being out of square have an injurious effect on the connecting rods and driving boxes inducing extra wear with a liability to fracture in crank pins. The loss by excessive friction in the wearing parts is very great. (3) See report of the Air Brake Convention in the present issue, and also Mr. Haley's letter on page 205.

BRAKE GEAR.

F. E., Copper Cliff, Ontario, writes:—Kindly answer in your next issue the way in which to get the proper length of brake rods and floating levers after re-arranging the auxiliary reservoir and brake cylinders. It is a tender that we are going to re-arrange the brakes on.—A. In determining the proper proportions of brake levers, or to determine the forces operating upon different pins, two forces and two distances are involved: one force is that which may be regarded as applied at one of three pins, and the other force as that delivered at another of the pins, while the remaining pin becomes the "fulcrum"; the two distances involved are those between the fulcrum pin and the pins at which the two forces are applied and delivered respectively. In every case, the product of the force applied at one pin and its distance from the fulcrum pin is equal to the product of the force delivered at the other pin and its distance from the fulcrum pin.

The accompanying table shows the comparative dimensions of standard body levers as established by the Westinghouse Traction Brake Company, and from which calculations in regard to brake levers are usually based:

DIMENSIONS OF STANDARD BODY LEVERS.

Diam. of Cylinder	Maximum Total Leverage Ratio	Length of Levers: Push Rod	Length of Levers: Cylinder	Section of Levers at Center
6"	12 to 1	26"	21"	3 " x ¾"
8"	12 to 1	26"	21"	3⅛" x 1"
10"	11 to 1	28"	28"	4 " x 1"
12"	10¾ to 1	31½"	31½"	5 " x 1"
14"	10 to 1	35"	35"	6 " x 1"

Distance from Push Rod to Tie Rod

Diam. of Cylinder	Maximum: Push Rod Lever	Maximum: Cylinder Lever	Minimum: Push Rod Lever	Minimum: Cylinder Lever	Diam. of Solid Tie Rod for Maximum Load
6"	12½"	10"	7"	5⅝"	¾"
8"	12½"	10"	8"	6½"	⅞"
10"	12¾"	12¾"	8"	8"	1"
12"	14⅛"	14⅛"	9"	9"	1⅛"
14"	15"	15"	10"	10"	1¼"

CONTROL VALVE DISORDER.

A. H. C., Wilmington, Del., writes: I have noticed a number of P. C. car brake equipments that have a blow from the port at the left side of the triple valve portion. What causes this? A.—Facing the valve the port at the left side of the equalizing portion is the reduction limiting chamber exhaust, and a blow at this point may be from the equalizing slide or graduating valve, the application cylinder cover gasket, the cap nut of the application portion, the emergency reservoir check valve, or from a combination of leakage from the parts mentioned. To determine the source of the blow, note in which positions of the control valve the blow occurs. If it exists in all positions, it is due to a leaky equalizing slide or graduating valve; if it occurs only after an ordinary service reduction, it indicates a leak past the cap nut of the application portion. If it only occurs in over-reduction position of the control valve, it indicates emergency reservoir check valve leakage, and if the blow is found to exist when the valve is in release position as well as in application position, it points to leakage from the application cylinder cover gasket. If it is found only in emergency position, it indicates a worn equalizing slide valve seat.

BRAKE STICKS.

A. H. C., Wilmington, Del., writes: I have noticed that in bleeding off brakes on cars that have type L triple valves the brake cylinder piston remains out 2 or 3 ins. We open the angle cock and the auxiliary reservoir bleeder cock, and why is it that under those conditions the brake does not fully release? A.—The failure to release is generally caused by either a stopped up brake cylinder leakage groove, a very strong triple valve slide valve spring, a weak brake cylinder release spring, or excessive packing leather friction. In bleeding off the brake in this manner, the triple valve does not move to release position, as opening the angle cock moves it to emergency position where it remains until brake cylinder and auxiliary reservoir pressure have reduced below the tension of the graduating spring. The graduating spring then returns the piston and slide valve as far toward release position as the travel of the stem will permit, in which position the auxiliary reservoir and brake cylinder volumes are separated. Brake cylinder pressure to be entirely exhausted, must unseat the triple valve slide valve and escape through the auxiliary, or escape due to leakage, and if there is no leakage the slide valve will be unseated when auxiliary reservoir pressure is practically exhausted, and when the slide valve spring again reseats the slide valve brake cylinder pressure will be at a figure so low

as to permit any remaining pressure to escape through the leakage groove in the cylinder. This will explain why the strong slide valve spring, closed leakage groove, weak release spring or packing leather friction may prevent the complete recession of the piston under the conditions you mention.

This is more liable to occur with the L triple valves than with the type P, on account of the larger slide valves in the No. 3 valve and heavier springs, and while it shows an imperfect condition of some part of the brake apparatus, the sticking can be avoided by bleeding off the brake entirely with the auxiliary reservoir cock wherein the triple valve remains in release position.

DROP IN CYLINDER PRESSURE.

J. H. B., Alexandria, Va., writes: After a full service reduction with the E. T. brake, I notice that, if the independent valve is then moved to application position, there is a drop in brake cylinder pressure. What causes this? A.—The drop in brake cylinder pressure is due to a flow of air from the application cylinder of the distributing valve through the independent valve to the reducing valve pipe and signal line. The full service reduction results in about 50 lbs. pressure in the application cylinder, consequently in the brake cylinders, and the reducing valve being set at 45 lbs., permits a back flow through the independent brake valve. To illustrate this, you may have noticed that, when using the signal whistle with the independent brake applied there is frequently a short exhaust from the distributing valve when the signal whistle sounds, especially if the application portion of the valve is in perfect condition and the reducing valve a trifle sluggish.

Private and Public Honesty.

Men have a clearer vision of integrity as individuals than as representatives of the people. Many of the men who have acted most unprincipled parts in politics have proved strictly honest in all their personal transactions. When a man does a dishonest act as an individual, he must accept the whole responsibility and cannot blind himself to the fact that he reaps the whole profit, whereas if he does such an act as the representative of the people, he shares the responsibility with other men, often of high standing in the community, and gives the whole profit to the people. The absence of personal gain, the sharing of responsibility, above all the generosity to the public, all tend to clarity of vision. Therefore if one desires to reach the morality of a nation he must appeal not to the government, but to the citizens.

This is why so many infamous laws are passed by legislators who are not personally dishonest.

The Southern Locomotive Valve Gear

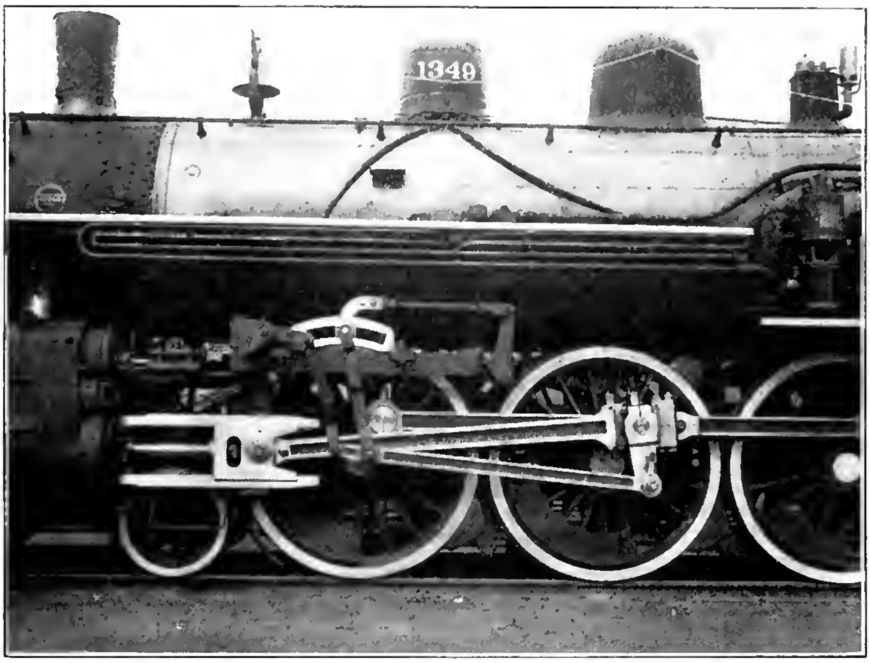
The application of the Southern Locomotive valve gear to a large number of locomotives built by the Baldwin Locomotive Works for the Southern Railway is an indication that the merits claimed for this type of valve gearing are based on a foundation of fact and the result will be watched with interest. In the February issue of RAILWAY AND LOCOMOTIVE ENGINEERING we gave some details in regard to the construction of the gearing accompanied with reproductions of drawings of the principal parts. We are now able to reproduce a photographic illustration of locomotive No. 1349, of the Southern Railway equipped with the gearing. It will be observed that the principal variation from the features of other similar types on valve gearing is that the links are located in a horizontal position and the links being stationary, it entirely has the effect of doing away with any perceptible wear at this point, as the block only moves when the reverse lever is moved.

As is well known the slip in the link is one of the chief sources of weakness in the operation of the shifting link, and the trouble is not altogether eradicated in the oscillating link of the Walschaerts valve gear. And not only is the rapid wear in the link almost entirely avoided, but the limited number of joints in the motion reduce the general wear to much less than half the usual amount, as in the case of the Southern valve gear there are only eight possible points of wear on each side, making sixteen points on both sides of the locomotive.

In addition to this advantage we have previously pointed out that there are no counterbalance springs, counter-weights or other balancing appliances required. There is literally no stress or strain upon the reverse lever and reach rod connections. Of recent years the difficulty in handling the reverse lever on the larger locomotives has become such that it is positively dangerous and appliances have been constructed for moving the reverse lever by the use of compressed air. The appliances although successful in their operation are of considerable cost and are not entirely free from the incidental disorders to which all mechanical appliances working under high pressure are liable.

It may be added that the design of the valve gearing, although newly applied in such form and under such conditions that it seems likely to come into favor, is not exactly new in the principle of using a link placed horizontally and acting by direct movement on straight lines In the early days of locomotive operation hundreds of experiments were made with endless varieties of valve gearing. Something similar to the Southern valve gear now placed in operation on the Southern Railway and known as the Hackworth gear, was tried, but found little favor, owing to the fact that the Stephenson valve gear, so-called, from its being introduced on the early locomotives built by Robert Stephenson, had the field almost to itself and served the purpose fairly well until the locomotives had grown to such dimensions that there was no longer room to conveniently repair or readjust the valve gearing in the limited space possible on the larger engines.

The working of the Southern valve gear will be watched with interest.



SOUTHERN LOCOMOTIVE EQUIPPED WITH SOUTHERN LOCOMOTIVE VALVE GEAR.

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Past and Future of Railroads.

We do not consider that Charles S. Mellen was ever a railway man worthy of the name, but he has succeeded in bringing a vast amount of opprobrium concerning methods of railway management upon men whose shoes he was unworthy to unloose. How a railway system developed that enabled a man like Mellen to manipulate its affairs in the scandalous fashion he did without finding himself behind prison bars is a mystery worth clearing up.

An article by William W. Cook, a conservative Wall Street corporation lawyer, contributed to *Harper's Weekly*, throws clear light upon the manner in which railway property passed from the control of the stockholders into the hands of the speculators who gave such men as Mellen their opportunity. The most salient part of the article reads:

"Commodore Vanderbilt was the first railroad king. He built railroads, consolidated them, ruled them as his own. He was not a banker nor a Wall Street financier. He raised the money by selling bonds in Europe and America. The bankers were his agents. Huntington, Crocker, Hopkins and Stanford were men of the same type. They built to the Pacific Coast. Hill did the same in the Northwest. Gould did the same in the Southwest. These men dominated their respective systems of railroads and took their profits in stock representing the surplus profits. They paid Wall Street only a commission for selling securities. They were the dictators of their roads.

"Then hard times came and created a new dynasty of railroad kings. The panic of 1893 swept away the watered stock. Great railroad systems were foreclosed. Bankers were the representatives of the bondholders, and the bankers bought in the railroads at foreclosure sales, using the bonds in payment. Bankers then reorganized the railroads and kept the stock, giving the old bondholders new bonds, with perhaps a sprinkling of stock. Even the old railroads which survived had to have vast sums of money and had to go to the bankers to get that money. Gradually the bankers acquired control of nearly all of the great systems of railroads in the country.

"The bankers dictated who should be the railroad presidents and who should be on the railroad boards of directors. The bankers controlled the policy as well as the finances of the railroads. The bankers sold the bonds and notes and new stock of the railroads. The bankers held the cash deposits of the railroads. Wall Street was the home of the bankers and hence Wall Street dominated the railroads.

"This second dynasty, however, has become decidedly unpopular. The bankers have brought about great consolidations which the public do not approve. The bankers caused purchases of railroads, trolleys and steamship lines to be made in order that the bankers might get large commissions. The bankers were guilty of improvidence, waste, extravagance and some crookedness in their control of the railroads.

"We had a right to expect prudence and reasonably good financing from the bankers, but they were guilty of financial recklessness, and, further, it is not the proper function of a banker to construct or purchase or operate a railroad or to engage in industrial enterprises, and when he does so there arises a conflict between his duty to the corporation and his interest as a banker."

A radical change in existing methods of railroad control is bound to come soon, if the worst system of management—government control—is to be avoided, and Mr. Wood, t[illegible] of the foregoing article proposes that a bill now pending in Congress for an Interstate Trade Commission should provide that the commission shall solicit and vote proxies at all elections of railroad corporations. The stockholders of railroads, scattered as they are all over creation, have no idea of how the property they are interested in should be managed, a duty which the officials of the Interstate Trade Commission could perform intelligently.

"The Interstate Commerce Commission controls railroad income by controlling railroad rates. Already the government largely controls railroad expenditures by increasing railroad wages through arbitrations. The government appoints a receiver upon corporate insolvency. All this is power without responsibility. The government should now assume the moral responsibility of representing the stockholders at corporate elections, it having taken control of corporate finances."

Information Requested on Car Wheels

The Standing Committee of the Master Car Builders' Association on Car Wheels of which Mr. W. C. A. Henry, Superintendent of Motive Power of the Pennsylvania Lines, at Columbus, O., is chairman, has sent out a very exhaustive circular calling for information on car wheels. The question of the strength and durability of car wheels is progressive, for every addition to the weight and carrying capacity of cars brings a new problem to the front, and the wheel that will endure the increased strains and shocks most successfully is the wheel that will come to the top through the process of natural selection.

The Committee request that the members of the Association make for one year, monthly or quarterly reports giving full information for all cast-iron and forged or rolled-steel wheels that have failed in ordinary usage due to cracks or breakage involving flange, tread or plate. Full particulars concerning the weight and capacity of cars are also requested.

All wheel markings that would tend to identify the design or specifications under which the wheel was manufactured, as M. C. B. 1907 or M. C. B. 1909 should be given. In the case of cast-iron wheels which have failed on account of broken flanges or a seam extending through the tread resulting in the flange breaking off, it is especially desirable that the thickness of the flange measured ⅜ inch above the base line be given.

Other particulars are requested which if given will give the Committee information that will form a most valuable report on car wheels.

Associated with Mr. Henry on this committee are Messrs. A. E. Manchester, R. W. Burnett, R. L. Ellenger, O. C. Cromwell, J. A. Pilcher and C. B. Young, all earnest workers and men likely to secure the information sought for.

Train Resistances.

A particularly strong committee of the American Railway Master Mechanics Association has been appointed to report at the coming Convention on Train Resistance and Tonnage Rating, a most important subject that will stand much earnest investigation.

The practice of rating the loading of locomotives according to their theoretical power has become so common, that the various resistances which have to be overcome in hauling trains of all kinds at varying speeds over all kinds of tracks, ought to be better understood than they are at present.

Until a few years ago what was known as Clark's formula was universally used in calculating train resistances. Kinnear Clark, the author of that formula, was a Scotch railway engineer who made many experiments with British locomotives and trains, the results having been made public in his well known book on Railway Machinery published about 1855.

According to Clark's formula, there is a resistance to train movements of eight pounds per ton, and the resistance increases with the speed at the rate of the square of the velocity in miles per hour divided by 171. American engineers had modified this to read six pounds per ton for the constant resistance, and accepted the remainder of the rule, so the common practice has become to calculate the resistance to trains on a straight level track to be

$$\frac{V^2}{171} + 6 = R$$

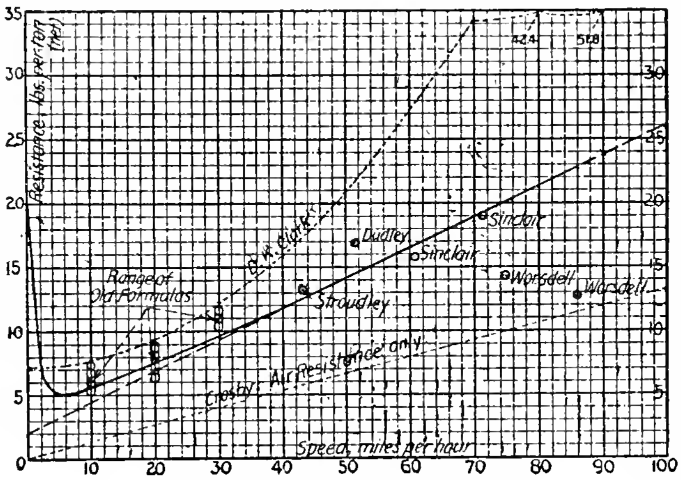


DIAGRAM OF TRAIN RESISTANCE.

That is V representing miles per hour and R resistance per ton. The rule stated in words is: Square the velocity in miles per hour and divide the result by, 171 add 6 to the quotient, the result being the resistance at the rail in pounds per ton. This is the rule formed in nearly all engineering text books and they are all wrong when applied to American trains.

In the early eighties Angus Sinclair was requested to make tests of a group of locomotives purchased by the Burlington, Cedar Rapids & Northern Railway which were reported to come shor. of their guarantee of power. He made a series of very carefully conducted tests, with indicator diagrams and water and coal consumption, finding that their power exceeded in every instance the rule given by the Clark formula which was then the only rule in use. This led to further investigations concerning train resistances, and discussions of the subject have been going on ever since.

By the courtesy of the New York Central management, Mr. Sinclair was permitted in 1892 to make a series of tests of the locomotive pulling the Empire State Express. In one of the runs made, a speed of seventy miles an hour was maintained for several miles and indicator diagrams were taken when the engine was doing the work of maintaining the speed without loss or gain. The power developed showed that the entire resistance of the train and the locomotive at that speed, was 17.6 pounds per ton.

In the discussions that arise periodically about what the ultimate speed of trains will be, arguments are advanced that after a speed of sixty miles an hour is passed, a point is soon reached where the locomotive will absorb the whole power developed in moving itself. Figures are always given to sustain this view, based on text book rules of train resistances. According to the Clark formula, so frequently used, the resistance per ton at 70 miles an hour is over 34 pounds. If this were true, there is not a locomotive in the country that could keep a train of 300 tons moving at a speed of 70 miles an hour.

The fact is that the square of the velocity does not in any manner represent the increase in train resistance due to acceleration of speed. This rule is utterly worthless and has no right to be used to deceive people who are striving to find accurate bases to calculate from. Its existence was evidently due to the desire of mathematicians to establish formulæ for everything. In this case, the formula was established without the necessary data upon which to build correctly.

A number of American railroad companies have used dynamometer cars for years, in which excellent provision is made for keeping an accurate record of train resistance. Those go to prove, not only that the resistance does not increase in proportion to the square of the speed; but that the resistance varies greatly according to the load per axle. On the Chicago, Burlington and Quincy Railroad, a great many records were made, years ago, to find out the resistance of different kinds of freight trains, with a view to finding out how many cars certain locomotives ought to haul. A train of loaded freight cars weighing 940 tons gave an average resistance of 5½ pounds per ton when running 20 miles an hour on the level. A train of empty freight cars weighing 340 tons showed a resistance of 12 pounds per ton while running 20 miles an hour on level track. A passenger train weighing 363 tons gave 7½ pounds per ton resistance at a speed of 30 miles an hour. The records respecting train resistance of the roads operating dynamometer cars agree substantially with the recorded resistance of the Empire State Express.

When the record of the tests on the Empire State Express were published, Arthur M. Wellington, a well known civil engineer and editor of the *Engineering News*, who had devoted much attention to the investigation of train resistance, wrote in his paper:

"The observations are among the most important evidences on record of the actual resistance of trains at high speeds. Perhaps we might even go farther and say that they are the most important, especially as they are reasonably consistent with the mean of the few other records which have been obtained for speeds of 50 to 75 miles per hour, while presumably far more trustworthy and decisive than any of the prior records. As such they are a real contribution to technical knowledge. We trust that they will attract the attention they deserve."

Mr. Wellington then made comparisons of the data, with those of a famous run made by Mr. Wm. Stroudley on the London, Brighton and South Coast Railway and with figures of train resistance found by Mr. P. H. Dudley in his tests with dynamometer car, with the discoveries made on air resistance alone by Mr. O. T. Crosby in experiments with a high speed electrically driven car. He remarked: "It is demonstrated by figures that Mr. Sinclair's record agrees substantially with the most reliable data relating to train resistances, and the annexed diagram has been plotted to give a graphic illustration of the rate of train resistance in pounds per ton."

The element of axle friction only in train resistances is fairly determined at about 4 pounds per ton for passenger and loaded freight cars and 6 pounds per ton for empty freight cars at a speed of 10 to 30 miles an hour. The general law of friction is also well determined at very high journal speeds, the lubricants are so well carried around between the metallic surfaces that friction is generally reduced.

It is now an admitted fact that the axle friction at the instant of starting is many times greater than after the vehicle is once

under way, and that the drop from this high resistance, while very rapid, is by no means instantaneous, but requires a speed of from 5 to 10 miles an hour before the normal rate is attained. The starting resistance at times rises considerably above 20 pounds per ton: i e., a car on a one per cent. grade, which gives an accelerating force of 20 pounds per ton, will very rarely start a car in motion. A fair average is 20 pounds.

While investigating the power of locomotives required to pull certain heavy fast express trains, Mr. S. A. Vauclain, of the Baldwin Locomotive Works, carried on a series of independent experiments, and he found the train resistance a little less than those formulated by Wellington from Mr. Sinclair's diagrams; but remarked that the figures were near enough for practical purposes.

From all the facts which we have obtained, added to Sinclair's and Vauclain's figures, we consider the subjoined table fairly represents

TRAIN RESISTANCE PER TON OF 2,000 POUNDS.

Miles per hour.	10	20	30	40	50	60	70
Heavy passenger trains, Sinclair	4.5	6	9.5	12	14	17	19
Vauclain	....	....	....	....	11	13	15
Loaded freight cars	4	5.8	9.2	11.3	12.5	..	..
Empty freight cars	6	7.5	11	14	17	..	..

The influential committee having this important investigation in charge has Mr. P. F. Smith, Jr., S. M. P. Pennsylvania Lines, Toledo, O., chairman, assisted by W. E. Dunham, C. & N. W. Railway, Winona, Minn.; E. J. Searles, B. & O., Pittsburgh, Pa.; H. E. Manchester, D. L & W., Scranton, Pa.; C. E. Chambers, C. of N. J., Jersey City, N. J.; J. H. Manning, D. & H., Watervliet, N. Y.; Frank Zalery, C. B. & Q., Aurora, Ill.

Safety First.

Safety first and efficiency afterwards has become the ruling injunction among a great many industries today. This is a desirable change from old careless methods that cannot fail to prevent much loss of life and suffering. The manner in which our mechanic trades developed from occupations free from danger, neglected provisions for safety until numerous fatal accidents emphasized the necessity for a combined movement to secure safety of workers. This originated the movement for safety first.

The movement for safety first is not confined to any particular country. It is world-wide. The authorities of the British Isles are particularly active in this movement. The latest Board of Trade returns of accidents on the railways in the United Kingdom makes melancholy reading. The number of passengers killed during 1912 was one in 68,100,000 transported, while the injured was one in 1,895,000 transported. Small as this ratio is, it is larger than that of previous years. The casualties to employees show an increase of about 200 over the previous year. One locomotive driver in 13,665 and one fireman in 12,709 were killed. Many of the accidents were preventable—that is to say, were due to lack of caution on the part of employees themselves. The figures prove, however, that railroading is a reasonable safe calling if the men are alert and act with ordinary intelligence.

In the United States the campaign for safety is carried on even to a greater extent than in the United Kingdom. Railroad workers are organized down to the commonest laborer through committees to seek some means of preventing accidents. The end sought is to eliminate altogether the avoidable accident. The avoidable accident is almost invariably one for which the employee himself is to blame.

Curious Measures of Power.

To the engineer and to many other people it is almost as important to have a measure of power as it is to have the ordinary weights and measures of domestic operations. A measure of power which is used in a great many ways is the horsepower equivalent to the raising of 33,000 pounds one foot per minute or its equivalent. Another method of expressing power greatly used in electrical measurements is the watt, which represents an electro-current of one ampere and electromotive force of one volt. One horsepower is equal to 746 watts.

In addition to these measures of power there are numerous fanciful estimates, such as man power, ox power, dog power, goat power, etc. It has fallen into the hands of a Scotsman with too much leisure on his hands to work out a mouse power. This man not only harnessed mice, but made the miserable animal a money-earning factor. He was David Hutton, a native of Dunfermline, the birthplace of Andrew Carnegie. Though he proved that an ordinary mouse would average a run of 10½ miles a day, he had one mouse which ran the remarkable distance of 18 miles in that time. A halfpenny's worth of oatmeal was sufficient for its food for 35 days, during which time it ran 362 miles. He kept two mice constantly engaged in the making of sewing thread for more than a year. This thread mill was so constructed that the mouse was able to twist twine and reel from 100 to 200 threads a day, Sundays not excepted. To perform this task it had to run 10½ miles a day, which it did with perfect ease every other day.

On the halfpenny's (one cent) worth of oatmeal, which lasted five weeks, one of these little mice made 3,350 threads, 25 ins. long, and as a penny was paid to women for every hank made in the ordinary way, the mouse at that rate earned ninepence every six weeks. Allowing for board and for machinery, there was a clear yearly profit from each mouse of 6s. It was Mr. Hutton's intention to apply for the loan of the Dunfermline Cathedral, which was empty, where he planned to set up 10,000 mouse mills, and still leave room for the keepers and several hundreds of spectators, but this wonderful project was never carried out because of the inventor's sudden death.

James Watt's Ideas of Locomotives.

We recently enjoyed the privilege of listening to a learned professor delivering an address on the development of steam power in which the statement was made that James Watt having had his attention directed to the power of steam by watching the lid of his mother's tea kettle vibrated by the vapor from the boiling water received the inspiration that resulted in the invention of the steam engine. That is a fairy tale that was told of other experimenters long before Watt's time.

Popular knowledge ought to inform people that the attention of James Watt, an instrument maker, was first directed to the steam engine through the request of the managers of the Glasgow University to repair the model of a Newcomen engine that was used for the instruction of students. The Newcomen engine was a remarkably crude apparatus for converting steam pressure into work, but it had a cylinder in which a piston operated, being the important elements on which all subsequent improvements on the steam engine were founded.

The speaker to whom we refer was highly enamored of Watt's inventive activity and credited him with leading to the invention of all the high class steam engines in use, including the locomotive. Here we must enter a protest. No man did more to retard the introduction of a locomotive engine than James Watt, and it is amazing the absurd views he held about the invention of what was afterwards known as a locomotive engine.

In the first place Watt was blindly wedded to the use of steam as close to atmospheric pressure as possible. His pet appliance was the condenser through which he aimed to obtain most of the power of the steam engine. Watt's best engines consumed from 6 to 10 pounds of coal per horse power per hour, and in a letter to Mr. Boulton written in 1786 he estimated that a locomotive engine must consume 20 pounds of coal and two cubic feet of water per horse power per hour—a rate which is four times the present ordinary consumption of railway locomotives. Not only did Watt discourage every improvement on the engine that involved the use of high pressure steam, but he did everything in his power to prevent the speed of the engine from being increased.

In spite of the opposition he had offered to others who were inclined to invent a locomotive engine, Watt patented one in 1784. According to his specifications the boiler was to be of wood or of thin metal strongly secured by hoops to prevent its bursting from the pressure of steam. There was to be an internal firebox and a number of tubes passing through a cylindrical boiler like the organ pipe condenser. A steam condenser was to be used and cold water carried to do the condensing.

No locomotive was ever built on the lines proposed in Watt's patent, and the engineering world suffered nothing from the omission.

Train Over Five Miles Long.

The theoretical tractive power of the Erie triplex locomotive, which we illustrated and described in last month's Railway and Locomotive Engineering, is 160,000 pounds. It is an interesting problem to figure out the length of trains that such an engine is capable of handling.

The internal resistance of this huge locomotive is estimated to be 8,000 pounds and 10 per cent. is deducted for other losses, leaving 137,000 available as tractive power in train hauling. Two trains of cars are given to this engine to haul on a level as under:

	First Train.	Second Train.
Capacity of cars, tons...	50	40
Average total weight of cars, tons	70	60
Total weight of train, tons	45,000	41,000
Number of cars in train.	640	680
Approximate length of train, feet	25,000	27,000

We publish particulars about these trains for the purpose of illustrating the amazing progress made of late years in loading locomotives to their fuel capacity and incidentally for indicating how the cost of transportation is under a course of reduction. One train is 4.73 miles long, the other 5.13 miles long. Like Dominie Samson we are moved to exclaim "prodigious!"

Early Abuse of a Railroad.

The early railroad journals were very free in their criticism of how our pioneer railroads were managed and operated. One of the first railroads put in operation in the United States was the Philadelphia & Columbia, which was promoted by the State of Pennsylvania as a rival to the Baltimore & Ohio Railroad.

The Railway Times in 1838, commenting upon the enterprise of the Pennsylvania politicians, said: The Philadelphia & Columbia Railroad, 82 miles long, is worse graded and worse operated than any enterprise of that nature to be found in the world. One inclined plane near Philadelphia is 2,800 feet long and another near Columbia is 1,800 feet long. The regular speed of trains on the level stretches is 13 miles an hour, on the inclined planes the speed is an unknown quantity. The motive power is mostly English engines, but there is a Norris engine, the George Washington, that can do more train handling than all the others combined. This is a six-wheel engine with cylinders $10\frac{1}{4}$ x $17\frac{5}{8}$ inches, drivers 48 inches, and in working order weighing 14,930 pounds.

Substitutes for Gasoline.

In a recent contribution to the Glasgow *Herald*, Mr. A. F. Sinclair, our British agent, writes:

At the present time various schools of investigation and experiment advise the use of one or other substitute for petrol, each one advocating its own pet hydrocarbon. Benzol, alcohol, and paraffin are the liquids mainly advocated, but only by alcohol is it held that petrol must ultimately be beaten. The others must necessarily be regarded as palliatives, not as a main supply, and as such they are doing good work in keeping down the prices of petrol. Investigation is in progress in Britain with respect to alcohol, and the French Government have offered valuable prizes for the discovery of a successful paraffin carbureter. Such a bit of mechanism can scarcely be characterized as a carbureter in the accepted sense of the word. As generally understood, a carbureter is a device which regulates the proportions of petrol spray and air drawn into the engine cylinder by the suction stroke of the piston. In the case of the Bellem and Bregeras machine the paraffin or other heavy mineral distillate is pumped into the combustion chamber and the suction stroke draws in a predetermined quantity of pure air. That in passing only, these paragraphs being more particularly concerned with the employment of alcohol as fuel. One of the strongest reasons why there is distrust regarding the use of alcohol as fuel is the fact that in both France and Germany—where agrarian interests are very powerful — attempts to employ alcohol as fuel have been unsucessful. Potatoes in Germany and beet in France are largely employed for alcohol production, and in Berlin coercion of a kind was used to compel the employment of alcohol as fuel in taxicab engines, yet it failed, and mineral spirit reigns supreme there as elsewhere. Dr. Ormandy, the high priest of the alcohol cult, endeavors to explain away the unfortunate argument involved in that failure, but it cannot be said that his arguments are as powerful as usual. Alcohol is not used as fuel simply because it is dearer and more troublesome than petrol even at its present price.

Getting on in Life.

We have recently come in touch with numerous college graduates who are looking to the railway field for a sphere on which their life labors may be hopefully devoted. The college atmosphere may be to blame for the prevailing sentiment among the graduates that they must be able to push forward without the slow labor involved in acquiring skill and knowledge.

We have all passed through periods of ambitious aspirations to get ahead without waiting the slow dull process of acquirement. We outline what we would like to be or to do and rest ruminating upon the goal of our journey, instead of taking the necessary actual steps towards it.

Yet taking that first step is all that we have to do *now;* the steps following we do not have to take till *then.* If one has to walk a mile or less, he does not sit eternally and think of what will occur at the end of his journey or anywhere along the way; he just sets out to walk. He does something now which might seem infinitesimal compared to his distance to be covered: he takes the first step. That is all he has to do; it is all he can do, now. That step taken—but not till then—comes the next step, and the next, and so on. The "left, right, left right" business is what brings him to his goal, and nothing else in the world will do it.

So in any journey, or pursuit, or ambition. Why, it is a fact that the very word "ambition" means a *going!* The next thing is all that we have to do. We can always find and take the very next step, though it may be a short one. Perhaps it is tightening a bolt, perhaps it is writing a letter, perhaps it is getting up in the morning with the alarm-clock instead of a couple of laps behind. Taking the next step is concentration; it starts things; it gives momentum; it opens the way. First thing one knows, one has arrived!

Four Good Habits.

There are four good habits—punctuality, accuracy, steadiness and despatch. Without the first of these time is wasted; without the second mistakes the most hurtful to our own credit and interest, and that of others, may be committed; without the third nothing can be well done; and without the fourth opportunities of great advantage are lost, which it is impossible to recall.

Business.

Business is dull, but not so hopelessly dull. So let howlers howl, and the growlers growl, and the prowlers prowl, and the gee-gaws go it. For behind the night there is plenty of light, and things are all right, and we know it.

Switchers for the Lehigh and New England Railroad and the Central Railroad of New Jersey

It will be readily observed that the greater part of the regular switching work in American railway yards and terminals is performed by six-coupled locomotives. Such engines, with short wheel-bases and the entire weight available for adhesion, are well fitted for railway yard work, and can be built of sufficient capacity to handle heavy tonnage. For the heaviest class of work, however, such as occurs in hump yards, or where the switching engines must handle the full trains brought in by the road engines, it is sometimes found to be necessary to have engines equipped with more than three pairs of driving wheels, and in such cases frequently eight-coupled, and even ten-coupled locomotives are being employed.

The accompanying illustrations represent two designs of light-coupled switching locomotives, which have been recently built by the Baldwin Locomotive Works. These engines are both in service on railroads using hard coal, and are fitted with boilers of the modified Wootten type. In both cases, also, saturated steam is used.

The locomotive for the Lehigh and New England is one of three which are designed to traverse 20 degree curves, and exert a tractive force of 46,200 lbs. The ratio of adhesion is 4.36, so that, with reasonable care, the full tractive force can be exerted without slipping.

The boiler used in this design is of the straight top type, and the firebox has a straight tube-sheet; no combustion chamber being used. The grate is of the rocking type, and the fuel is a mixture of bituminous coal and buckwheat anthracite. This is supplied through two 16-inch doors. The dome is placed just ahead of the firebox, but back of the cab which is located over the middle of the boiler barrel. This arrangement allows a door of full height to be placed in the back of the cab, and facilitates access to the firing deck.

The steam distribution is controlled by balanced slide valves, and these are driven by Walschaerts valve gear, and the valves are set with a lead of 3/16 of an inch. The reverse shaft is placed under the cab, and the reverse lever is ahead of it; the two being connected by a short reach rod. The equipment of this locomotive includes flange oilers for the front and back driving wheels.

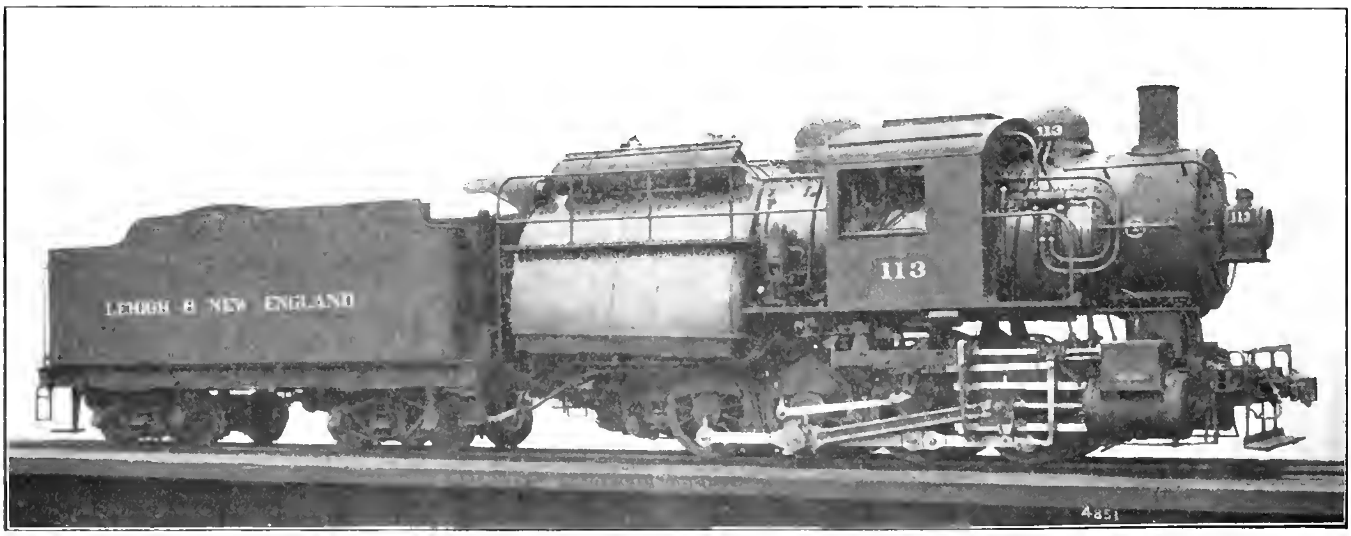
The type of locomotive for the Central Railroad of New Jersey is larger than those for the Lehigh and New England, although similar to them in many respects. This type of locomotive exerts a tractive force of 52,400 pounds, and with 23,000 pounds on driving wheels the ratio of adhesion is 4.38, or practically the same as that of the Lehigh and New England type of engine. There are five of these locomotives built to drawings and specifications furnished by the railroad company.

The boiler has a conical connection at the rear end of the barrel, and the firebox is built with a short combustion chamber, or D-head. Flexible bolts are liberally used in the water spaces, and the front end of the crown is supported by three rows of this type of stay. The grate is composed of rocking-bars and water tubes, and fine anthracite is used for fuel.

The steam distribution in these locomotives is controlled by 13-inch piston valves, which are driven by Walschaerts valve motion, and are set with a lead of 1/16 of an inch. This is considerably less than would be used in a road engine. Among the details of the driving gear may be mentioned the main and side rods which are of forged vanadium steel.

The tenders supplied with these locomotives are to be transferred to passenger engines, and are equipped with pneumatically operated water-scoops. The tender frames are of cast steel.

The following are the principal dimensions of both of these types of locomotives.



SIX-COUPLED LOCOMOTIVES FOR THE LEHIGH & NEW ENGLAND RAILROAD
R. L. Wyman, Master Mechanic. Baldwin Locomotive Works, Builders.

LEHIGH AND NEW ENGLAND SWITCHERS.

Gauge—4 ft. 8½ ins.; cylinders, 22 ins. by 28 ins.; valves, balanced slide.

Boiler—Wootten straight; diameter, 74 ins.; thickness of sheets, 13/16 ins.; working pressure, 200 lbs.; fuel, buckwheat and soft coal mixed; staying, radial.

Firebox—Material, steel; length, 126⅛ ins.; width, 108¼ ins.; depth, front, 61¾ ins.; depth, back, 55 ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water space—Front, 5 ins.; sides, 4½ ins.; back, 4½ ins.

Tubes—Material, steel; thickness, No. 12 W. G.; number, 333; diameter, 2 ins.; length, 14 ft. 6 ins.

Heating surface—Firebox, 220 sq. ft.; tubes, 2,513 sq. ft.; total, 2,733 sq. ft.; grate area, 95 sq. ft.

Driving wheels—Diameter, outside, 50 ins.; diameter, center, 44 ins.; journals, 10 ins. by 12 ins.

Wheel base—Driving, 14 ft. 3 ins.; rigid, 14 ft. 3 ins.; total engine, 14 ft. 3 ins.; total engine and tender, 49 ft. 8 ins.

Weight—On driving wheels, 201,300 lbs.; total engine, 201,300 lbs.; total engine and tender, about, 360,000 lbs.

Tender—Wheels, number, 8; diameter, 33 ins.; journals, 5½ ins. by 10 ins.; tank capacity, 8,000 gals.; fuel, 14 tons; service, switching.

SWITCHERS FOR THE CENTRAL RAILROAD OF NEW JERSEY.

Gauge—4 ft. $8\frac{1}{2}$ ins.; cylinders, 24 ins. by 30 ins.; valves, piston, 13 ins. diam.

Boiler—Type, conical connection; diameter, 78 ins.; thickness of sheets, $\frac{3}{4}$ in. and $\frac{13}{16}$ in.; working pressure, 200 lbs.; fuel, fine anthracite; staying, radial.

Firebox—Material, steel; length, 122 ins.; width, $108\frac{1}{4}$ ins.; depth, front, $65\frac{3}{4}$ ins.; depth, back, 55 ins.; thickness of sheets, sides, $\frac{3}{8}$ in.; back, $\frac{3}{8}$ in.; crown, $\frac{3}{8}$ in.; tube, $\frac{5}{8}$ in.

Water space—Front, 4 ins.; sides, 4 ins.; back, 4 ins.

Tubes—Material, iron; thickness, No. 11, W. G.; number, 401; diameter, 2 ins.; length, 15 ft.

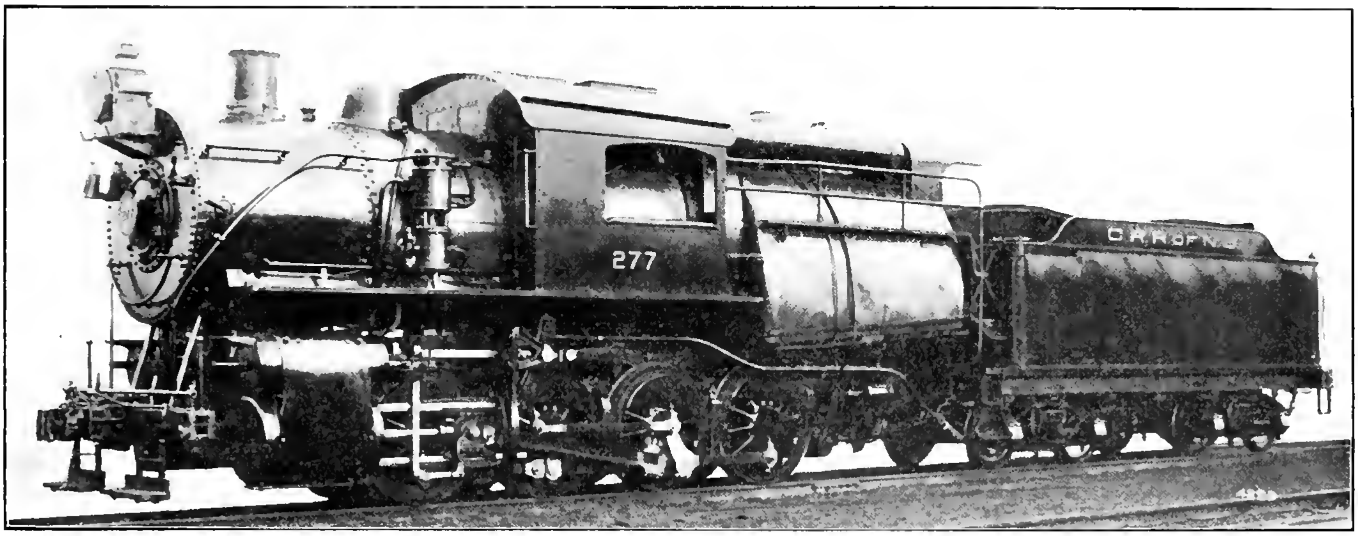
Heating surface—Firebox, 202 sq. ft.; combustion chamber, 18 sq. ft.; tubes, 3,132 sq. ft.; total, 3,352 sq. ft.; grate area, 91.6 sq. ft.

Driving wheels—Diameter, outside, 56 ins.; diameter, center, 48 ins.; journals, main, 11 ins. by 12 ins.; journals, others, 10 ins. by 12 ins.

Wheel base—Driving, 15 ft. 3 ins.; rigid, 15 ft. 3 ins.; total engine, 15 ft. 3 ins.; total engine and tender, 49 ft. $10\frac{1}{8}$ ins.

Weight—On driving wheels, 230,000 lbs.; total engine, 230,000 lbs.; total engine and tender, about 375,000 lbs.

Tender—Wheels, number, 8; diameter, 36 ins.; journals, $5\frac{1}{2}$ ins. by 10 ins.; tank capacity, 7,500 gals.; fuel capacity, 12 tons; service, switching.



SIX-WHEELED LOCOMOTIVES FOR THE CENTRAL RAILROAD OF NEW JERSEY.

C. E. Chambers, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Decision in Patent Suit.

The suit of John B. Tate vs. the Baltimore and Ohio Railroad Co., which was brought for alleged infringement of the Tate Patent No. 643,560, dated February 13, 1900, for a firebox expansion pad, was tried before Judge Rose and a jury in the United States District Court, Baltimore, Md., on April 20, and a verdict for the defendant was rendered, under the instruction of the Court, on the ground of the invalidity of the patent sued on.

This suit is of importance to railroad companies generally, as it was an attempt to cover the well-known attachment of the firebox to the frames through the mud-ring instead of through the side sheets, and if it had been decided adversely to the Baltimore & Ohio Railroad, other of the numerous roads using this arrangement would doubtless have been attacked. It was, however, shown that such constructions had been known and in use since 1862, and the precise arrangement of the Tate patent was shown in the Sharp British Patent No. 3558 of 1879.

Messrs. J. L. Levy and O. E. Edwards, Jr., of New York, argued the case for the plaintiff, and Messrs. W. A. Redding and J. Snowden Bell, of New York, for the defendant.

Smoke-Makers and Others.

A locomotive engineer now holding a good position as road foreman of engines on one of our trunk lines, once wrote to the editor of this paper: "I have had some experience lately of the methods followed by different firemen, that I think notes of two trips would be both interesting and instructive.

"The first man commences his work in starting out as if his father owned the mine that supplies the coal without seeming to reason how or why. Burn as much coal as possible was the idea that seemed to regulate his labor. With the wind behind, in one hour and fifty minutes he passed from the tender into the firebox more than 8,000 pounds of coal. The engine did not steam well because the fireman was too busy making smoke.

"The following day I made the same run with the same engine and train, and about the same weather conditions, but with a different fireman. I suppose it was because I have not fully recovered from the excitement caused by witnessing the facts of the previous day that made me think fireman No. 2 was indifferent. He put in lots of time at the station before leaving smashing little chunks of coal that were already smaller than the firebox door. Two minutes to leaving time and no black smoke! I got my delay blank out, filled in date and signed all ready to hand in at terminal with time lost and cause—no steam.

"But we are off through the city, no smoke; out into the open country; fireman acts as if he did not realize that we were running fast, and that I was pounding her. Occasionally two, more often one shovel of coal passed quietly through the furnace door. No smoke yet, and the gauge pointed steady at the 190 figure. Furnace door ajar, fireman watching a dangerous crossing half a mile ahead. No smoke. I look at steam gauge, and he appears to have the pointer nailed to 190. I feel the injector feed pipe by the gauge corks. He notices my embarrassment and blows out the water glass. His movements directed by his brain are adjusted to circumstances. Terminal on time. Coal consumed about 4,500 pounds. Saving of coal 3,500 pounds.

"My conclusion, based on the two last runs, is that the employment of first-class firemen is the most profitable enterprise a railroad company can undertake. The introduction of road foremen of engines on that road proved disastrous to the No. 1 fireman. He would not change his methods."

Graphite.

The National Graphite Lubricator Company, Scranton, Pa., have appointed Flint & Chester, New York, as the Company's selling agents for the East, including the railroads north and east of Buffalo and Baltimore.

Air Brake Department

Air Brake Convention.

The 21st annual convention of the Air Brake Association at Detroit, Mich., was addressed by Mr. W. A. Garrett, chief executive of the Pere Marquette Railroad on the general subject of railroad management.

Inasmuch as the air brake man is seldom, if ever, taken into the confidence of the railroad management, his remarks were of particular interest, especially those relating to railroad freight rate legislation.

The air brake department of a practical mechanical publication is not unduly interested in political matters, but at the present time the maintenance of air brake efficiency is seriously hampered by adverse railroad legislation, and to such an extent that railroad associations are compelled to take note of it.

We are compelled to admit that public sentiment is formed largely by newspaper reporters, to whom the science of railroad operation is an unknown quantity, and as this sentiment is sensed by the people's representative, his plans for reelection are guided thereby, hence it is but logical to conclude that reform in railroad legislation must begin with the public, and that newspaper reporters should be in possession of some of the facts and statistics that are presented before the railroad associations, before airing their opinions through the columns of the daily papers.

Mr. Garrett made no reference whatever to the press, but rather explained the attitude of the railroad toward, and its dependence upon, public support. He stated that railroad management has now resolved itself into such a simple proposition that anyone can manage a railroad, and that but very few people hesitate to tell how easily it can be done.

Instead of a summing up of the railroad situation in general, those remarks were confined to the Pere Marquette system, and other lines were mentioned only for the purpose of comparison. Mr. Garrett has thoroughly analyzed the situation, and explained very clearly why the Pere Marquette has failed to pay dividends. According to the statistics presented the road is compelled to accept 6 mills per ton mile for hauling freight, and that the earning capacity of each employee averaged about 5 cents per day under present conditions. This performance was compared with the Pennsylvania Railroad as to the amount of traffic in both freight and passenger service, and to population per square mile of territory in which both roads operate.

With reference to scientific management, an instance was cited in which it cost the Pere Marquette $30,000 to prepare and print freight tariffs, and when completed were ordered suspended, but at the same time the legislators were advising scientific management.

We do not care to make any comment upon Mr. Garrett's remarks, but they are entitled to as much consideration as those of any efficiency experts who tell the public how much money they could save for the railroads per annum through scientific management.

W. J. HATCH,
President, A. B. Ass'n, 1913-14.

THE CABOOSE AIR GAGE AND CONDUCTOR'S VALVE.

The first paper on technical subjects was: "The Caboose Air Gage and Conductor's Valve," by Mr. Mark Purcell. This paper dwelt upon the importance of the conductor's valve, and particularly the air gage in caboose cars, outlining the correct methods to be employed in the installation and maintenance of the same. The reading and subsequent discussion brought out the fact that the gages and conductor's valves have now become a necessity to insure the maximum possible degree of safety under the various conditions that enter into freight train operation.

Quite a number of the members cited numerous instances in which the observation of the caboose gage prevented wrecks, derailments and runaways, and mentioned other instances in which wrecks, accompanied by loss of life, occurred, which could have been prevented had the caboose contained a gage, and indicated to the train crew the depletion of pressure in the brake pipe.

A new feature in the way of a manufacturers' exploitation meeting was arranged in the convention hall wherein the exhibitors were encouraged to explain the advantages to be derived from the use of their products.

In this connection a new form of air hose coupling was introduced for the purpose of eliminating the angle cocks from brake pipes. This form of coupling automatically closes itself when hose are uncoupled by hand, and brake pipe remains open when hose are pulled apart as in the case of break-in-two of train. Brake pipe opening can be closed manually when disconnected, but cannot be recoupled without opening the brake pipe passage, and absolutely cannot be closed while hose are united. The use of this hose coupling is designed to eliminate the liability of the closed angle cock in air brake operation.

A new form of air pump metallic piston rod packing, known as the "Universal Flexible" type, was shown, which at a first impression appears to be the most practical form of metallic packing for air pump piston rods yet introduced.

At the commencement of the second day's session, the association officially noted the passing away of the inventor of the air brake, and a sincere and simply worded resolution expressing regret and assurance of sympathy of the entire body was conveyed to Mrs. George Westinghouse, and Mr. George Westinghouse, son of America's, if not the world's, greatest benefactor.

CLASP TYPE OF FOUNDATION BRAKE GEAR.

As the regular order of business was resumed, Mr. T. L. Burton was called upon to present a paper on the subject of "Clasp Type of Foundation Brake Gear," at which time Mr. Burton stated that, owing to a misunderstanding upon his part no paper had been prepared. He, however, demonstrated that he could prepare and present a technical paper upon the spur of the moment.

His extensive knowledge of the subject, and experience in dealing with the foundation brake gear problem enabled him to handle the subject from memory, and with as well chosen sentences as could be desired in any prepared paper. Mr. Burton places particular emphasis upon the design and installation of the clasp type of brake gear for passenger

cars, pointing out that the mere application of two shoes per wheel does not insure the improvements sought in foundation brake gear efficiency.

It is shown that there is a possibility of such an incorrect design of clasp brake rigging as will render it inferior to the standard one-shoe per wheel rigging. The correctly designed clasp brake rigging is a decided and necessary improvement, which we will bring to the attention of our readers in a future issue.

AIR HOSE FAILURES.

Mr. T. W. Dow presented a paper containing a further report of his investigations along the subject of "Air Hose Failures." The method of mounting air hose by machine versus by hand received due consideration, during which time it became apparent to the listener that air hose can be mounted, one end at a time, by machinery, without injuring the inner lining of the hose.

Other matters pertaining to air hose and hose gaskets were discussed, and the use of the gage for hose gaskets was strongly advocated, and the coupling groove cleaning tool was again recommended.

LECTURE BY MR. W. V. TURNER.

In the afternoon the entertainment consisted of a lecture by Mr. W. V. Turner, who was at his best, and the members of the Air Brake Association who were fortunate enough to be at the convention heard the greatest air brake discourse that has ever been delivered at any time or place.

Mr. Turner chose for his subject the development of brakes for passenger cars from the plain triple valve to the electro-pneumatic brake, and each stage was illustrated with lantern slides. The apparatus used was prepared expressly for the occasion at an expenditure of several thousand dollars, and the members were unanimous in the expression of their appreciation of the efforts of the Westinghouse Air Brake Company to furnish the air brake information they are in search of.

The members appreciate the fact that Mr. Turner has reached a position in the mechanical world, and advanced the air brake art to a point where his able assistant engineers can be relied upon to handle all the details of design and manufacture, but during convention time he chooses to lay aside all business no matter how urgent, and become a railroad air brake man.

On this occasion Mr. Turner spoke very rapidly, and concluded in a little less than four hours, and was permitted to do so principally because the hotel management insisted.

Comparatively speaking this was fast work, as the writer recalls instances when, after a strenuous day's session, the discussion was continued in the hotel lobby until 2 a. m., and in one instance until 4 a. m., before Mr. Turner could make his escape.

This is not particularly the work of air brake fanatics, but if a number of men are interested in air brake matters to such an extent that they will remain in the convention hall all day, and sit up all night for the purpose of obtaining the information they are seeking, some good results are sure to follow.

When Mr. Turner's lecture is in print it will be entitled: "The Electro-Pneumatic Brake,' and his opening remarks were as follows:

"Such a subject as that which is to be presented to you can obviously be divided and subdivided into many parts. For example, we might divide on the question as to whether or not the devices we are to consider will or will not perform the functions attributed to them. This your speaker will not consider, for

W. V. TURNER,
Chief Engineer, Westinghouse A. B. Company.

in the first place it would be an insult to your intelligence to debate it, since he believes there is not a man here but who knows enough of the laws of physics to, in his own mind as slide after slide appears, mentally go through a process of the resolution of forces, and so conclude that the device must operate or a miracle occur to prevent it. In the second place the devices have already seen so much service that even the most skeptical would not consider a debate possible.

"Again we might divide the matter into two parts on the ground of necessity, some of us holding that such a device, since it exists, is a necessity, because it gives better results than any other device, while others might take the position that it is not a necessity since up to quite recently we got along without it. This is generally the position taken by those who oppose progress, and obviously can be used to block anything new, and if the words and actions of those opposing a new thing on these grounds had been followed we would still exist in the same state of civilization as did Adam, and would still be digging roots with our finger nails for a living. While the vagaries of the human mind are given considerable latitude by our creator, this particular one is under the ban, for few of you have seen an opposer of progress obtain any particular advantages in life, on the one hand, while the difference between the present state of civilization and the time when Adam started the struggle between the wise and the foolish is evidence that gentlemen of the let-well-enough-alone class have had but little, if any, influence. However, like the insects of which Gladstone once spoke, they are annoying at times, but do little real harm. Anything is necessary that puts human progress and welfare one step ahead.

"On the other hand, even though some might accept the statement that improvements were not necessary because of having got along so far without them, yet it is incumbent upon the sponsor of this statement to show that conditions are still the same as those of the get-along period of which he is speaking. In other words, his statement really begs the question and means nothing.

"Again, we might divide upon the question of whether the acceptance and use of all the new functions to be shown to you are desirable, and here we may properly divide, since your speaker himself believes that in some cases all of them are very desirable at once, while in other cases some may be desirable of incorporation at once and others not. Also that it may even be that the old is good enough where conditions have not materially changed since the old was first employed. Thus in the last analysis it comes down to an understanding of the apparatus, what it is for, and what are the profits in safety and revenue to be derived from it, and it is this that those concerned must decide for themselves or leave in the hands of competent engineers to do it for them. One thing sure is that ignorance will excuse no one, nor will it give them the profits to be derived from the use of these devices; therefore, to ignore the great possibilities of increasing railroad capacity, which I shall present to you, cannot be classed as business sense, and your speaker is encouraged to believe you agree with him from the fact that you are here, and that you now, as generously as has been the case for many years past, have the same desire to encourage him and assist him in his endeavor to serve you and those whom you represent. You see, then, that the question resolves itself into how much of the device, and how many of the functions you can use for the benefit of the public, and consequently to the profit of the road."

Mr. Turner then proceeded to explain the object of each feature in turn that was added to the triple valve during its development into the universal valve, pointing out each shortcoming of the triple valve in modern train operation and how they were corrected in the design of the "built-up" equipment. Now we hope to make it clear that this lecture was not staged for the purpose of advertising the electro-pneumatic brake, because the Westinghouse company employs better advertising mediums than the Air Brake Association.

There is no doubt that it sometimes appears that certain association papers and articles in this department tend to advertise the products of the air brake manufacturers, but such intention is far from the desire. Our chief aim is to secure air brake information that will be a help to the air brake inspectors and repairmen and the only way reliable information can be obtained on air brake matters is by test.

Air brake instruction must be free from opinions; we no longer care what a man thinks on any subject, it is what he knows from actual demonstrations that is of practical value.

Mr. Turner made it clear that this brake was designed expressly for the Pennsylvania railroad and upon their demand that certain features of triple valve operation be improved upon and others eliminated, and contrary to expectations 80 per cent. of the improvements in the universal valve are upon the service brake operation, while so much reference to emergency stopping distances lead to the impression that this was in the main the only consideration.

Further than this the brake is not now recommended for general passenger service on the ground that it cannot become a necessity until the possibilities of present brake equipments have been exhausted, which will not be as long as brake rigging efficiency in some cases as low as 60 per cent. of the assumed total. He further pointed out the folly of attempting to utilize the improved high pressure features in connection with an ordinary or inefficient brake rigging, as such rigging would be torn out from under the car. Mr. Turner concluded by saying:

"I sincerely hope that my anticipations have been fulfilled and that this method of treating the subject has been both interesting and profitable. At first it might appear that my only purpose has been to explain the functions possessed by the universal valve, but as a matter of fact such is not the case.

"My real purpose has been to present to you, as clearly and as forcibly as I might, the present state of the art of passenger train braking, for this paper covers, though somewhat briefly, it is true, practically everything that is known about air actuated mechanisms for passenger services brakes. A person thoroughly conversant with the principles and functions expressed herein can be truthfully said to know practically everything that has been learned by experiments and trial of the operation of air actuated brake mechanisms.

"It is not within my province to expatiate here upon the merits and advantages of the universal valve and when the question of complexity of universal valve mechanism arises, it is obvious that the operation is in no wise more complicated than that of the triple valve, as in either case the application and release is controlled by a differential in pressure created on the sides of a single piston."

At the opening of the third day's session the paper on "100 Per Cent. Efficiency of Air Brakes," by Mr. Von Bergen, was read by Mr. J. A. Barry.

L. H. ALBERS,
President, Air Brake Association, 1914-15.

The paper is an unusually short one and to the point, expressing the opinion that 100 per cent. efficiency can never be obtained. The discussion following develops what is meant by 100 per cent. efficiency, which Mr. Von Bergen seems to have mistaken for the expression perfect. It would be contrary to the law of transformation of energy to expect any machine to actually be 100 per cent. efficient, but the realization of 90 per cent. braking power in passenger service or 70 per cent. in freight, combined with an equipment maintained according to recommended practice, may be considered 100 per cent efficient. The discussion, however, shifted to the consideration of brakes 100 per cent. operative and means for attaining this end were considered, and several members stated that their instructions were to have brakes on freight trains 100 per cent operative leaving terminals. This naturally led to recommendations for means whereby this condition may be maintained. The matter will again be brought to the attention of the association at the next convention.

"The Electro-Pneumatic Signal System for Passenger Trains," by L. N. Armstrong, was read, discussed and accepted. It is well known that the standard pneumatic signal equipment when operated on trains of from 12 to 15 cars is not absolutely reliable under all conditions, in fact, it was never intended or devised to operate on trains of such length, consequently the requirements for a signal have long exceeded the capacity of the present system.

The electro-pneumatic signal was developed for electric service some years ago, and several systems were described by Mr. Armstrong.

As electric current is now available on the majority of the long passenger trains in steam road service the electric systems are available.

The electric systems are simple and absolutely reliable and one type was in use for several months on the Pennsylvania railroad test train at Absecon, N. J., in 1913 and was found to be entirely satisfactory. Mr. Armstrong urged the association to investigate the merits and fix upon the most desirable type for steam road trains and recommend it for use before a variety of systems find their way into use. The systems, whether installed with low voltage battery current or high voltage line current, is instantaneous in its action, absolutely reliable and can be depended upon to transmit signals correctly and distinctly, eliminating entirely the elapsed time between the pulling of the cord and the signal reaching the engineer, no matter how fast the cord is pulled or how short an interval is allowed between blasts, it is absolutely free from false signals, and very economical to maintain, having no rubber diaphragms or hose connections to deteriorate, or any parts requiring expert repairmen for delicate adjustments.

The last paper on the list is entitled "Modern Train Building," in which the author, Mr. G. W. Nolan, comments upon the importance of an improvement over the general practice employed in the make-up of present day freight trains. He has made quite a number of experiments to determine a desirable and convenient method in making up mixed trains of loads and empties and while it is not strictly an air brake paper, the make-up of trains is a very important factor in brake manipulation to conform to successful handling of such trains.

At the close of this paper the recommended practice of the association was reviewed and suggestions as to changes considered and the regular routine of business was concluded.

There seems to be a tendency upon the part of a certain per cent. of the members to broaden out the scope of convention business. Mr. Von Bergen in his brief contribution found an opportunity to contemplate astronomy, while a special session tended more or less toward zoology. Considerable interest was manifested in a species known as the Badger, evidently a piece of mechanism inhabiting the State of Michigan, and possibly other sections of the country.

So far as certain members have been able to determine, the fighting instinct of the animal is still an unknown quantity.

The following were elected officers for the ensuing year: President, Mr. L. H. Albers, New York Central Lines; first vice-president, Mr. J. T. Slattery, Denver & Rio Grande; second vice-president, Mr. T. W. Dow, Erie Railroad; third vice-president, Mr. C. H. Weaver, Lake Shore & Michigan Southern; secretary, Mr. F. M. Nellis, Westinghouse Air Brake Company; treasurer, Otto Best, Nathan Manufacturing Company. The new members elected to the Executive Committee were: Mr. L. P. Streeter, Illinois Central, and Mr. Mark Purcell, Northern Pacific. The Convention was one of the largest since the organization, about 300 being present.

Universal Valve Improvement.

Any new and untried mechanical device, no matter how appparently perfect it may operate during laboratory tests, is very likely to develop some unexpected or undesirable feature after being installed in service. Even if it should meet every expectation, there is always the possibility of improvement upon some feature when actual results are obtained.

The universal valve for passenger cars has been no exception to the general rule; practically perfect in the rack tests, it has been discovered that certain features in its operation could be improved upon.

The Westinghouse Company anticipated this and consequently were very reluctant to furnish any description of this device or consent to assist in the publication of any matter concerning it, until such time as it had been subjected to a service test for a sufficient length of time to develop any undesirable results.

Actuated by a desire to publish up-to-date matter in the Air Brake Department, and to furnish the readers with the description of the operation of the universal valve and the principal disorders that could reasonably be expected to develop from wear or neglect, we have lost no opportunity to secure everything possible for publication, and at a time when it is of utmost value, i. e., when the apparatus is first placed in service.

Any measure of success the writer has met with in railroad air brake work has been entirely due to a constant desire to learn everything possible about a new air brake device before the company purchased and installed it.

The first electrotype, showing a diagrammatic view of the universal valve, that we were able to secure was used in the January issue, and it has served the purpose for which it was intended, namely, to enable the reader to become familiar with the construction and operation and as a reference to be used when tracing the source of possible disorders, as outlined and commented upon in subsequent articles that have already appeared in print.

While listening to Mr. Turner's lecture and observing the slides shown, it was gratifying to note that but a very few changes have been made in the latest type of valve.

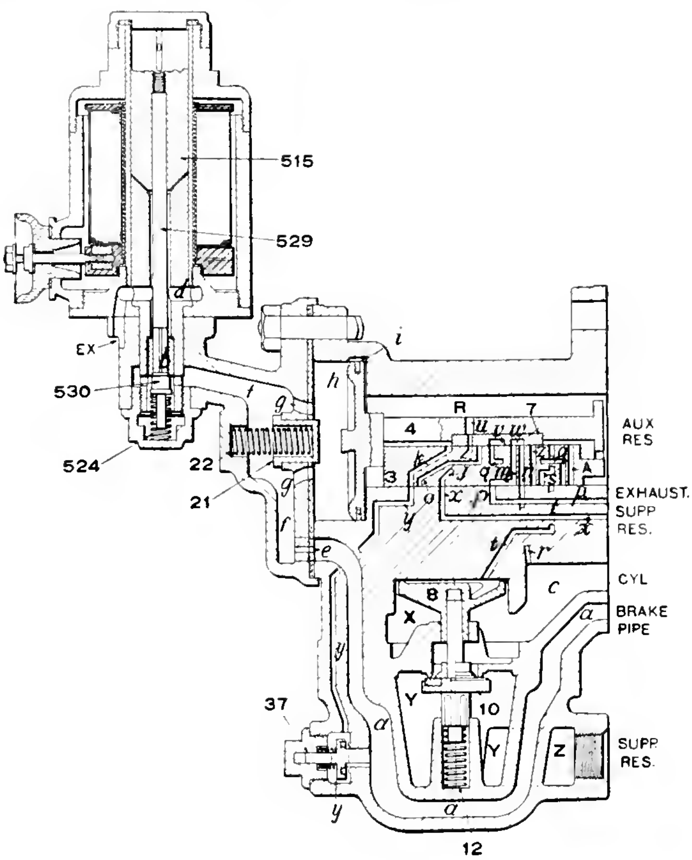
There is no change in operation or general construction, the changes being confined to such as replacing the service port check valve and the emergency reservoir charging check with ball check valves.

To prevent the possibility of an undesired drop of auxiliary reservoir pressure by expansion into the service reservoir under certain conditions, a ball check valve and seat have been placed in the port connecting service reservoir and equalizing slide valve seat. Provision is also made for charging the service reservoir from the emergency volume (while the graduated release cap is in direct release position) promptly upon an increase of brake pipe pressure.

This is to insure a prompt response of brakes in the event of repeated applications at short intervals of time during the transition period.

The feed groove has also been eliminated from the emergency piston bushing and instead a ball check valve and seat is placed in the quick-action chamber charging port to prevent the addition of quick-action chamber volume to the brake pipe during applications.

During the service reduction, the emergency piston and graduating valve move to open the quick-action chamber to the atmosphere, permitting the same rate of drop in pressure on both sides of the emergency piston up to the maximum permissible rate of brake pipe reduction for service operation.



R-2 C TRIPLE VALVE.

The addition of the emergency graduating valve and the improvements mentioned will be explained in detail in connection with cuts showing the universal valve in different positions.

It will now be possible to secure the necessary electrotypes, and they will be shown in future issues.

At the present time we have an electrotype that illustrates, in the simplest possible manner, the application of electric current to the operation of a pneumatic brake. This is a diagrammatic view show-

ing exactly the principles upon which electric control operates, and anyone understanding the operation of a triple valve cannot fail to understand that in running position all magnet valves are in their normal position and that the service magnet is energized and operated only in service position of the brake valve, and the emergency magnet is energized and operated in emergency position, while the release magnet valve is normally open and energized in release position and also in lap position to retain brake cylinder pressure. By this combination it is obvious that the brakes can be graduated on or off in any manner desired, or rather brake cylinder pressure can be varied up or down instantly and simultaneously on every car in the train. While this is merely an illustration, the cut of the R-2-C triple valve shows an actual electrically controlled valve which has been in electric road service for some years.

While we believe in doing it first and telling about it afterward, we are sure that the readers of the Air Brake Department will pardon us for announcing that for the remainder of this year the department will contain the most instructive matter on modern brake equipments and brake design that has ever appeared in this or any other technical publication. We say this advisedly, for there is no past time in the history of the air brake art when this information could be obtained.

Next month some extracts from, and comments upon, a paper read by Mr. Turner before the Central Railway Club will appear, and thereafter the subject of air brake tests, with particular reference to the Pennsylvania-Westinghouse demonstrations, will be dealt with, and at the same time the recent improvements in the universal valve will be shown in diagrammatic views.

Split Reductions.

The term split reduction is a recent addition to the air brake nomenclature, but it is one that must be understood by engineers in passenger service, and not merely understood but practiced.

In connection with articles on the subject of passenger train braking we have pointed out why reductions of not less than 10 or 15 pounds must be made in order to secure a prompt and positive release when handling modern brake equipments on long passenger trains, thus if a six-pound reduction stops the train from low speed a further reduction of 5 or 6 pounds must be made after the train stops before attempting a release, which is in itself a split reduction.

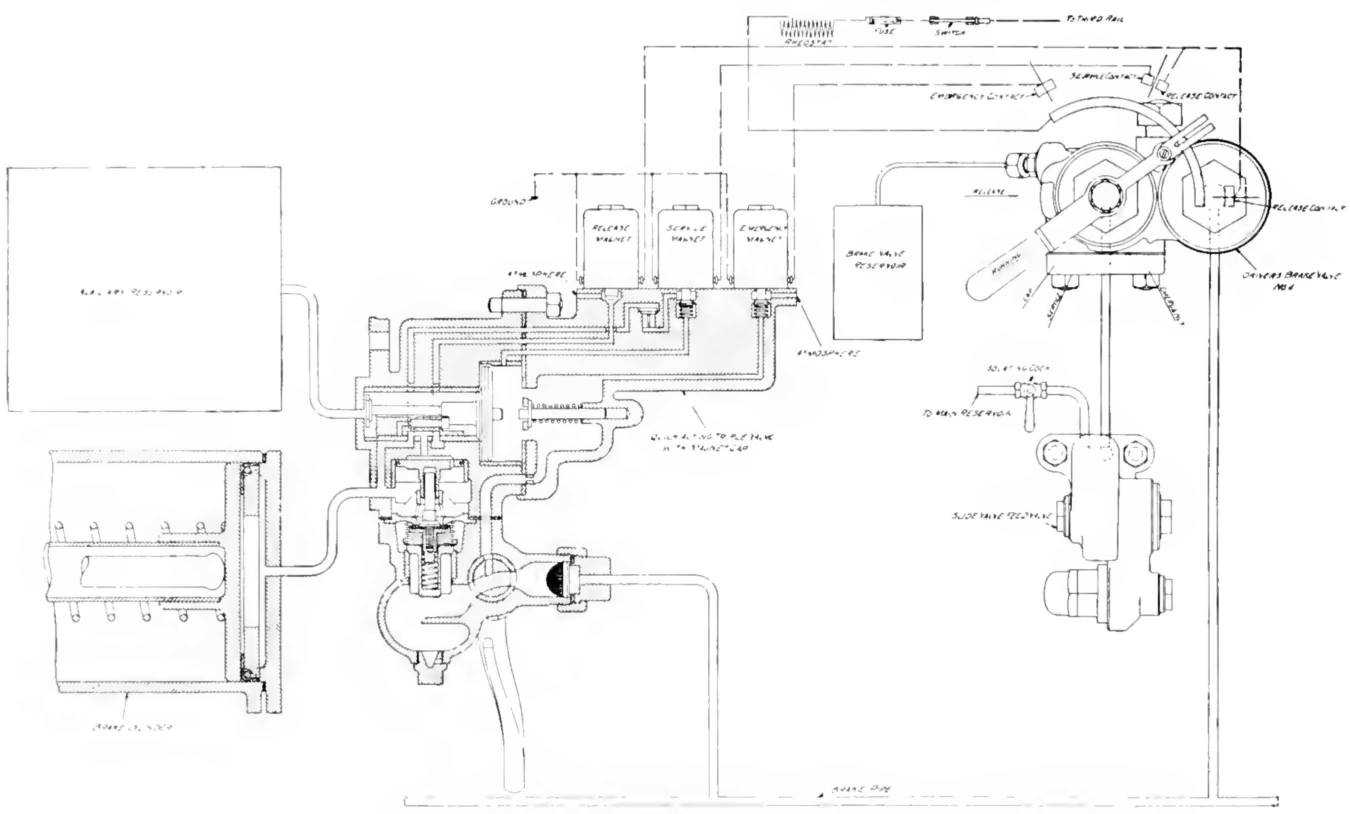
It is generally understood that with one complete brake equipment of any certain type a 20 to 25 pound reduction at high speeds is a recommended practice, and with triple valves a two application stop can be made and with type L. N., or the P. C. equipments the high brake cylinder pressure can be graduated out of the cylinders when near the point of stop; however, where time and distance are not the chief consideration during a stop or at a moderate rate of speed, this split reduction is an essential if the smoothest possible stop is desired. Where a 12-pound reduction is necessary for a stop split up in two 6-pound reductions or if 15, say 7 and 8 pounds, allowing time between reductions for the slack to adjust itself. The amount of slack in a long passenger train is sufficient to require consideration, and can under certain conditions, produce some very undesirable effects.

First Person to Operate a Sewing Machine Alive.

History has been so rapidly in the making during the last half century that the younger generations regard the product of modern inventors as something the world has always enjoyed. Take the sewing machine, for instance. A newspaper item recently mentioned that Miss Elizabeth M. Kilbourn, the first woman to operate a sewing machine, is lying ill in a New England hospital.

In the early fifties Miss Kilbourn was teacher in a private school in New Hartford when Elias Howe was experimenting with his invention in a dingy shop in a basement on the present site of the New Hartford House. She became interested in his invention and was finally permitted to operate it.

"There, you are the first woman in this world who ever took a stitch on a sewing machine," Howe said to Miss Kilbourn when at his invitation she tried the machine.



PRINCIPLES OF THE APPLICATION OF ELECTRIC CONTROL TO A PNEUMATIC BRAKE SYSTEM.

Hay-Budden American Made Anvils

The Hay-Budden Manufacturing Company, of Brooklyn, began the manufacture of anvils in America near the close of the last century, and by the use of the best material and the best appliances available, together with smiths that were artists in their calling and a reasonable protective tariff, a new industry was established, and several hundred American workmen enjoyed a high rate of wages and the works spread into acres and the foreign made anvil vanished from the American market. The firm has been almost without a rival, and their fine products have found new markets in almost every country in the world. One would marvel what comes of the anvils. They are as enduring as the pyramids. But the world widens and when a new railroad shop springs into being a row of anvils are set in shining splendor along the far-stretching smithy and the words "Hay-Budden" are stamped upon them. Go to the uttermost ends of the earth, to the Sandwich Island or the Philippines, and you will hear their bell-like notes waking the echoes keeping time with the march of civilization. In new battleships, in mines, in the glow of camp-fires, in the train of armies—they are there.

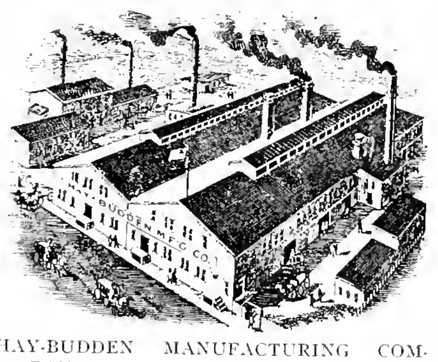
A big fire consumed the original buildings in one winter night, but it proved to be the furnace fires out of which the pure gold comes. A steel and brick structure rose on the ruins of the early buildings, and it defies the elements, and so the business went on and with improved appliances the output multiplied, so that the fire was a blessing in disguise. This was not all. The tariff-tinkers began to get their fine work in, and the American workmen, earning about thirty-six dollars per week, had to compete against Scandinavians and other Northern Europeans earning less than nine dollars per week. Mr. James Hay, president of the firm of the Hay-Budden Company, personally presented a masterly statement before the Ways and Means Committee of the House of Representatives last year, but the political steam roller was at work, and Mr. Hay's convincing statement and array of facts and figures fell upon inattentive ears. The tariff was lowered to a mere fraction, with the result that the anvil industry together with all industries in this country that have to compete with cheap foreign labor have become almost demoralized, and the promoters are at their wit's end to meet the industrial situation.

Structurally the Hay-Budden anvils were originally steel faced, and, although these served the purpose admirably, the present method is a combination of a wrought iron base and the upper part of the best quality of high carbon steel. The change has not been made because the anvils are thereby made more durable, but because the construction is more expeditious. The steel and iron billets are shaped into form as it were with the rapid closing of the ponderous presses, and all that is left to do is the welding at the waist and some finishing work on the horn of the anvil.

It may be added that the methods and

HAY-BUDDEN AMERICAN MADE ANVIL.

appliances used in the grinding and tempering of the anvils have also reached a degree of perfection that can only come from long experience, and finally the testing involves processes that justify the guarantee that accompanies each particular anvil when it reaches the hands of the purchasers. It need hardly be stated that the anvils are of all varieties and sizes, the numerous dies used in the hydraulic presses being constructed for every kind



HAY-BUDDEN MANUFACTURING COMPANY'S WORKS, BROOKLYN, N. Y.

of anvil in use, so that in meeting specific orders where the complete dimensions are given there are no delays in filling the order.

This firm has also since they started in business made a specialty of dies and special tool steel forgings, and steel rings without a weld, which are meeting with much popular favor.

Welding Copper.

Nearly all scientists and metallurgists entertain the belief that the ancients had methods of working and hardening copper that have been lost. We notice from a statement in a German publication that a physicist in Germany has succeeded in welding copper. Two pieces of copper, placed in position, are heated to the proper point by the oxyhydrogen blowpipe until the requisite degree of softness is attained. Complete reduction is then effected in a flame of specially purified hydrogen and the welding is completed by hammering. According to the inventor of this operation, the joint is invisible and the area of juncture is homogeneous with the rest of the metal.

Annual Meeting of the Joseph Dixon Crucible Company.

At the annual meeting of the stockholders of the Joseph Dixon Crucible Company, held at the company's main office in Jersey City, N. J., last month, the retiring board of directors, consisting of Mr. Geo. T. Smith, Mr. William Murray, Mr. George E. Long, Mr. Edward L. Young, Mr. William G. Bumsted, Mr. J. H. Schermerhorn and Mr. Harry Dailey, were unanimously re-elected.

The meeting was attended by a large number of stockholders who expressed satisfaction with the present management and recorded the largest vote ever represented at an annual election, 9,628 out of a possible 10,000 shares being represented.

The officers of the company, consisting of Mr. Geo. T. Smith, president; Mr. George E. Long, vice-president; Mr. J. H. Schermerhorn, treasurer; Mr. Harry Dailey, secretary, and Mr. Albert Norris, assistant treasurer and assistant secretary, were also re-elected.

Removal.

The general offices of the United States Light & Heating Company, formerly located at 30 Church street, New York City, are now located at the company's plant at Niagara Falls, New York. This transfer brings together the administration, sales, engineering and production departments, and will insure the most effective conduct of all in the interests alike of patrons and stockholders.

An Attractive Government Job.

When the United States Government officials desire to engage the services of a specialist, the amount of remuneration offered is generally decidedly meagre for the requirements. A recent announcement calls for the services of an efficient stenographer and typewriter who has a knowledge of German and one other foreign language. For these acquirements of salary of $1,000 per annum will be paid.

Electrical Department

Arc Welding.

Arc welding, at the present time, is receiving a great deal of attention by railroads, railways and industrial concerns, because of the many advantages it possesses for certain kinds of work. It is particularly adapted to various uses in machine shops and foundries. Worn parts of machines can be built up prior to machining. Broken parts of steel castings can be welded together. It is a common occurrence to find defects in new castings after considerable machining has been done, which ordinarily means scraping of the casting at high cost for material and labor lost. The machining and castings, in almost every case, can be saved by repairing with the electric arc. Sometimes mistakes are made which can be corrected by building the metal up again with the electric arc and thus the job is saved. Castings with blow holes and sand holes can often be very quickly repaired. Another use to which the arc welding outfit can be put is the foundry cutting off risers and sinkheads.

VIEW OF AN OPERATOR MAKING A WELD ON A STEEL RING.

SURFACE BUILT UP ON TRUCK SPIDER.

The arc welding outfit is specially advantageous in steam locomotive shops where *metal pencil welding* is used extensively in fire box and boiler repairs, flue welding, repairing steel locomotive frames, building up mud rings and general work of this character. A large amount of equipment that would have to be scrapped can thus be repaired with the electric arc, and a large saving in money, time and labor effected.

In electric railway shops *arc welding* can be used to special advantage in repairing broken armature shafts, axle brackets and motor frames. In track equipment the repair of broken frogs, cross-overs and other similar work can be done with excellent results.

As mentioned above, there are two different methods of welding, each adapted to its own particular line of work, namely, *metal pencil welding* and *arc welding*.

In *arc welding* a carbon is used, and usually with heavy electric currents from 200 to 800 amperes. The method used in welding a broken casting is to cut the metal away in the form of a V on one side and a little more than half way through using the carbon and several hundred amperes of current. The current is then reduced to about 200 amperes and the V filled in. Sticks of Norway iron are used and the arc is moved around so as not to burn the metal and also to allow the molten metal to harden. There is more or less slag according to the grade of the iron, but an operator after a little practice can keep the weld clean from slag, the slag being worked to one side and blown off by the arc. After filling up the V the piece is turned over, another V cut out and the process repeated.

With *metal pencil welding* no carbon is used, but a metal rod with a diameter of 1/8 to 1/4 in. is put in the holder. The electric current flows through this rod and the small arc at the end melts it off, the same being deposited on the piece to be welded. Smaller currents are used, usually not exceeding 200 amperes.

There are many places where the welding outfits can be used to advantage, and the accompanying illustrations are a few of the many jobs which can be done. In each case a Westinghouse arc welding equipment was used. Eight years ago the Westinghouse Electric & Manufacturing Company first commenced to use the electric arc in its own shops. Realizing the practical value of arc welding, the company within the last two or three years has developed a standard line of electric arc welding equipments in four sizes: 200, 300, 500 and 800 amperes. These sets are made simple in construction and are easy to operate. Experience shows that a relay scheme for automatically inserting resistance is not of any advantage and only adds complication with a liability for failure.

REPAIRING BROKEN LOCOMOTIVE FRAME.

The complete outfits consist of a 75-volt

commutating pole generator which can be either motor or belt driven, together with a switchboard and all necessary accessories. The switchboard is composed of two sections, the upper section containing the indicating instruments together with the circuit breaker and fuses, and the lower section the switches arranged for regulating the welding current. The connections to these switches are such that different values of current are obtained with the different positions of the switches, the current usually varying by 100 amperes; for instance, with a 600-ampere set it would be possible to obtain 200, 300, 400, 500 and 600 amperes. When metal pencil welding is desired, a different set of switches with different resistance is usually used, so that smaller values of currents are obtained usually from 150 amperes to 300. It is often desired to have several welding outfits working at one time and all that is required is a control panel for each circuit, the current supply being taken from the same generator. Metal pencil or carbon welding

ARC WELD ON BACK FLUE SHEET OF STEAM LOCOMOTIVE.

can be done from any of these panels, independent of all others, and one or more can be operated simultaneously.

There is a peculiar property of the electric arc which makes it necessary to protect the eyes and skin. The arc being very bright would, of course, make it necessary to protect the eyes, but besides this the rays will "sunburn" any parts of the body even if only exposed for short periods.

The operator, to protect himself, wears gloves and a metal hood over the head, provided in the front with a window in which is placed at least three layers of glass of different colors, usually red, green and purple.

After experience the operator becomes very skillful and can turn out remarkable work.

An Interesting Electric Locomotive.

For handling cars at their Cleveland ore docks, the Pennsylvania Lines West have recently had built three locomotives of unusual design. The most novel feature in these locomotives is that they do not run on the same tracks as the cars they handle, but on narrow gauge (42-inch) parallel tracks. They are not attached to the cars by couplings, but each locomotive is equipped with an arm on each side which can be lowered by means of compressed air controlled from the cab and acts as a pusher. Single cars or trains can be easily handled and cars can be shifted and cut out from trains with the least time and trouble.

The locomotives are of Baldwin-Westinghouse make and are 25 tons in weight. They have barsteel frames, which give great strength but permit ready access to the interior. The motors are of the Westinghouse electric commutating-pole type. Power is obtained from two rails lying inside the rails on which the locomotives operate; these rails are protected by a wood covering.

Railroad Switching Service—The Adaptability of the Electric Locomotive to this Class of Work.

The New York, New Haven & Hartford Railroad have in service sixteen electric switching locomotives which have been handling all of the switching for the past year and a half at the New York end of this great railroad. This road handles 75 per cent. of all freight in and out of New England by rail.

There are three main switching yards,

	Length.	
Harlem River yard...	23.3	miles
Oak Point yard......	37.16	"
Westchester yard	22.29	"

and the economies obtained by the use of the electric locomotive in these great yards have exceeded all expectations. The reliability of the switcher locomotive has proven to be far superior to the steam locomotive. To date not a single feature has developed in which the electric locomotive is not superior to the steam locomotive in switching service. The ease with which electric locomotives are controlled, the elimination of stand-by losses and those that are necessary where coal and water are used, elimination of liability for freezing up in cold weather, are all features which are to be credited to the electric locomotive.

Six single-phase electric locomotives do the work of approximately twice the number of steam locomotives formerly used. A total of eight of these electric locomotives are sufficient for practically all of the switching work between Stamford and Harlem River station. These are kept in service 24 hours a day, each making on the average of approximately 140 miles in 24 hours with three eight-hour crew shifts. The electric locomotives handling the work between Westchester yard and Harlem River for a given month made 38,000 locomotive miles and consumed approximately 896,000 kilowatt-hours of electrical energy at the locomotive.

During this same period, the six locomotives handled approximately 65,000 cars which had a total weight of approximately one million tons. Practically all of these cars were transferred from floats, and since the control of the electric locomotive is more sensitive than the control of the steam locomotive, this is a feature that appeals strongly to the operators.

All of the heavy freight tonnage mentioned above is handled within the corporate limits of New York City, and the elimination of smoke by the use of the electric locomotive is another advantage which has appealed to all parties.

The Automatic Flagman.

The automatic flagman is a device to protect railway grade crossings by giving effective warnings of the approach of trains. With the rapid increase of automobiles running at high speeds, something more than the old "Stop, Look and Listen" sign is necessary, which is too unobtrusive to attract the attention of the motorist and which at night is practically worthless.

These objections cannot be applied to the automatic flagman. At the approach of a train a loud gong rings and a bright red disc by day and a red lamp by night is waved, giving a warning that can hardly escape notice. Energy is supplied by a small Westinghouse motor which rings the gong and moves the disc.

The motor receives its energy from storage batteries lighting circuits, or trolley circuits, depending on the character of the installation. On steam roads, the track is insulated and bonded for the desired distance away from the signal and is charged with current from a small battery. The train on entering this block completes the circuit and operates a relay, which connects the motor with the power circuit. When the train leaves the block the circuit is opened and the motor disconnected.

The device is manufactured by the Automatic Flagman Company, Los Angeles, and the illustrations show an installation on the Pacific Railway Company, of Los Angeles, where the Beach Line crosses a road entering Rosedale Cemetery.

This machine, which is one of several hundred "Automatic Flagmen" on the lines of the Pacific Electric Company, operates about 300 times a day with an average duration of about 1½ minutes each.

The Electric Short Line Railway Company, Minneapolis, Minn., will place in operation two additional 70-ft. gas-electric motor cars recently ordered from the General Electric Company.

Items of Personal Interest

Mr J. A. Baker has been appointed foreman on the Santa Fe, with office at Belen, N. M.

Mr. A. E. Fischer has been appointed master mechanic on the Interstate, with office at Stonega, Va.

Mr Leon Sloss has been elected president of the Northern Electric, with office at San Francisco, Cal.

Mr. A. L. Tetus has been appointed car foreman on the Great Northern, with office at Cass Lake, Minn.

Mr. C. L. Sykes has been appointed master mechanic of the Orangeburg, with office at Orangeburg, S. C.

Mr. A. B. Newell has been appointed general manager of the Toledo terminal, with office at Toledo, Ohio.

Mr. E. C. Comstock has been appointed road foreman of engines on the Santa Fe, with office at Clovis, N. M.

Mr. L. R. Eccles has been appointed president of the Mount Hood Railroad, with office at Ogden, Utah.

Mr. Z. Ramsdell has been appointed car foreman on the Great Northern, with office at New Rockford, N. D.

Mr. F. Heim has been appointed master car builder on the Midland Continental, with office at Jamestown, N. D.

Mr. H. C Fleitmann has been elected president of the Union & Glen Springs, with offices at New York, N. Y.

Mr. A. Guild has been appointed master mechanic on the Hawaii Railway, with office at Makukona, Hawaii, H. I.

Mr. F. Stone has been appointed road foreman of engines on the Chicago & Alton, with office at Slater, Mo.

Mr. E. O. Holland has been appointed master car builder on the Snowbird Valley, with office at Andrews, N. C

Mr. B. D. Richardson has been appointed master mechanic on the Midland Valley, with office at Muskogee, Okla.

Mr. H. W. Ensign has been appointed master mechanic on the Chicago-Great Western, with office at Clarion, Ia.

Mr. M. A. Monahan has been appointed locomotive foreman on the Chicago-Great Western, with office at Chicago, Ill

Mr. P. W. Helwig has been appointed master car builder on the Chicago & Alton, with office at Bloomington, Ill

Mr C. McLean has been appointed locomotive foreman on the Chicago-Great Western, with office at Oelwein, Ia

Mr. F. A Phillips has been appointed locomotive foreman on the Great Northern, with office at Great Falls, Mont.

Mr. W. F Gallup has been appointed general foreman on the Santa Fe, Western Lines, with office at Raton, N M.

Mr. J. Bleasdale has been appointed master mechanic on the Baltimore & Ohio, with office at Benwood, W. Va.

Mr. A. D. McCharles has been appointed locomotive foreman on the Great Northern, with office at Havre, Mont.

Mr. J. M. O. Hollman has been appointed master mechanic on the North Louisiana & Gulf, with office at Hodge, La.

Mr. C. H. R. Howe has been appointed master carpenter on the Baltimore & Ohio, with office at Chillicothe, Ohio.

Mr. T. McClain has been appointed master mechanic on the Arkansas, Louisiana & Gulf, with office at Monroe, La.

Mr. F. Kubeck has been appointed foreman of shops on the Chicago & North-Western, with office at Green Bay, Wis.

Mr. A. L. Firnhaber has been appointed master mechanic on the New Iberia & Northern, with office at New Iberia, La.

Mr. A. L. Ellis has been appointed master mechanic on the Charles City Western, with office at Charles City, Ia.

Mr. G. N. Gage has been appointed road foreman of engines on the Baltimore & Ohio, with office at Connellsville, Pa.

Mr. J. H. Schmidt has been appointed foreman of locomotive repairs on the Chicago & Alton, with office at Bloomington, Ill.

Mr. H. K. Lowry has been appointed signal engineer on the Chicago, Rock Island & Pacific, with office at Chicago, Ill.

Mr. William Eastman has been appointed foreman on the Nevada County Narrow Gauge, with office at San Francisco, Cal.

Mr. J. D. Costello has been appointed general foreman on the Denver, Laramie & Northwestern, with office at Denver, Colo.

Mr. A. A. Pedneau has been appointed master mechanic on the Pascagoula, Moss Point Northern, with office at Moss Point, Miss.

Mr. N. G. Scott has been appointed general manager of the Spokane & Inland Empire, with office at Spokane, Wash.

Mr. L. L. McGowan has been appointed master mechanic on the Pacific & Idaho Northern, with office at New Meadows, Idaho.

Mr. J. D. Gaboury has been appointed master mechanic of the Woodward Iron Company's railroad, with office at Woodward, Ala.

Mr. T. Kerlin has been appointed supervisor of locomotive operation on the Baltimore & Ohio, with office at Cumberland, Pa.

Mr. J. B Gough has been appointed road foreman of engines on the Baltimore & Ohio, with office at Wheeling, W. Va.

Mr. J. McComack has been appointed master mechanic of the Nevada County Narrow Gauge, with office at Glass Valley, Cal.

Mr. R. H. Gaddus has been appointed foreman of the tin and pipe fitting shops on the Intercolonial, with office at Moncton, H. B.

Mr. A. E. Herrold has been appointed master car builder on the Monongahela connecting railway, with office at Pittsburgh, Pa.

Mr. R. A. Logan has been appointed master mechanic on the Denver, Laramie & Northwestern, with office at Utah Junction, Colo.

Mr. W. E. Cavey has been appointed supervisor of locomotive operation on the Baltimore & Ohio, with office at Baltimore, Md.

Mr. B. F. Crolley has been appointed supervisor of locomotive operation on the Baltimore & Ohio, with office at Wheeling, W. Va

Mr. J. E. Sentman has been appointed road foreman of engines on the Baltimore & Ohio, with office at Riverside, Baltimore, Ohio.

Mr. N. J. Westermark has been appointed signal supervisor on the Chicago, Milwaukee & St. Paul, with office at Tacoma, Wash.

Mr. J. C. Basford has been appointed assistant road foreman of engines on the Baltimore & Ohio, with office at Philadelphia, Pa.

Mr. J. H. Sims has been appointed general foreman on the Cincinnati, New Orleans & Texas-Pacific, with office at Ludlow, Ky.

Mr W. A. Deems has been appointed assistant master mechanic on the Baltimore & Ohio, with office at Glenwood, Pittsburgh, Pa.

Mr. J. Desmond has been appointed road foreman of engines on the Delaware & Hudson, with office at Colonie (P. O. Watervliet), N. Y.

Mr. B. F. Orr has been appointed division car foreman on the Cleveland, Cincinnati, Chicago & St. Louis, with office at Indianapolis, Ind.

Mr. W. J. Nehr has been appointed general foreman of the locomotive department on the Baltimore & Ohio, with office at Benwood, W Va.

Mr. J. G. Lewis has been appointed road foreman of engines on the Cincinnati, New Orleans & Texas-Pacific, with office at Ludlow, Ky.

Mr. H. P. Blake has been appointed superintendent of water supply and heating on the Canadian-Northern, with office at Winnipeg, Man.

Mr. J. T. Luscombe has been appointed master mechanic on the Baltimore & Ohio, with office at Parkersburg, W. Va., succeeding Mr. J. B. Elliott.

Mr. C. W. Robertson has been appointed general foreman of locomotive repairs on the Chicago, Burlington & Quincy, with office at Aurora, Ill.

Mr. C. D. Summers has been appointed general foreman of the locomotive department on the Baltimore & Ohio, with office at Fairmont, W. Va.

Mr. J. B. Dougherty has been appointed road foreman of engines on the Baltimore & Ohio, with office at Newcastle (P. O. Mahoningtown), Pa.

Mr. A. J. Barrett has been appointed assistant master mechanic on the Cleveland, Cincinnati, Chicago & St. Louis, with office at Bellefontaine, Ohio.

Mr. W. F. Heinbach has been appointed engine house foreman on the Philadelphia & Reading, with office at East Penn Junction (P. O. Allentown), Pa.

Mr. E. B. Horner has been appointed general foreman of the locomotive department on the Baltimore & Ohio, with office at Clarksburg, W. Va.

Mr. C. T. Mandler has been appointed general foreman of the locomotive department on the Baltimore & Ohio, with office at Barleys, Baltimore, Md.

That veteran master car builder John Kirby was ninety years old in October last and he looks about the same as most veterans do at sixty. Wishing you many returns of your birthday, my good friend, John.

Mr. W. F. Heiser, master mechanic on the Chicago & East Indiana, has been transferred from Villa Grove, Ill., to Evansville, Indiana shops, and Mr. F. Studer, formerly master mechanic on the same road at Evansville, has been transferred to Villa Grove, and Mr. F. R. Ruggles, formerly general foreman at Evansville, has been transferred to Villa Grove, and Mr. Charles H. Lutz has been appointed general foreman at Evansville. Mr. Lutz has been acting as local agent for RAILWAY AND LOCOMOTIVE ENGINEERING for a number of years, and claims that those who peruse its pages cannot fail to obtain promotion.

Mr. Donald R. MacBain, president of the American Railway Master Mechanics' Association, the well-known and accomplished superintendent of motive power of the Lake Shore & Michigan Southern, has had an interesting and stirring career as a railway man, and is still in the prime of life. He is from Queenston Heights, Ontario, Canada, and was educated in the common schools there. He entered railway service in 1876 as machinist apprentice on the Canadian Southern, since which he has been consecutively, from 1878 to 1882, locomotive fireman; 1882

MORGAN K. BARNUM,
President, Master Car Builders' Association.

to 1890, locomotive engineer on the same road; 1890 to 1893, traveling engineer Canada division Michigan Central; May, 1893, to July, 1900, traveling engineer district west of the Detroit river on the same road; 1900 to 1901 master mechanic

DONALD R. MAC BAIN,
President, American Railway Master Mechanics' Association.

at Michigan City, Ind.; 1902, master mechanic at St. Thomas, Ont.; 1902 to 1906, master mechanic at Jackson, Mich.; 1906 to 1908, assistant superintendent of motive power on the same road at Detroit, Mich.; 1908 to 1910, assistant superintendent of motive power, New York Central & Hudson River at Albany, N. Y.; May, 1910, to the present, superintendent of motive power on the Lake Shore, Lake Erie & Western; Lake Erie, Alliance & Wheeling; Dunkirk, Allegheny Valley & Pittsburgh; Cleveland Short Line; Chicago, Indiana & Southern, and Indiana Harbor Belt Road.

Mr. Morgan K. Barnum, president of the Master Car Builders' Association, has had a notable career as a railway man. He is a graduate of Syracuse University with the degree of Master of Arts. He entered railway service as a special apprentice in the shops of the New York, Lake Erie & Western at Susquehanna, Pa., 1887 to 1889; general foreman on the same road at Salamanca, N. Y. In 1889 he was general foreman on the Louisville & Nashville at New Decatur, Ala. In 1890 he was appointed superintendent of shops on the Union Pacific a Cheyenne, Wyo.; 1891 to 1898 he was district foreman on the same road at North Platte, Neb.; 1898 to 1902 master mechanic on the same road at Omaha, Neb.; 1903, assistant mechanical superintendent on the Southern. In 1904 he was superintendent of motive power on the Rock Island, and from 1904 to 1910 mechanical expert on the Chicago, Burlington & Quincy, and from 1910 to 1913 general superintendent of motive power on the Illinois Central and Yazoo & Mississippi Valley, and at the present time is employed as general mechanical engineer on the Baltimore & Ohio with offices at Baltimore, Md.

Mr. W. D. Cantillon, formerly general manager of the lines east of the Missouri river of the Chicago & North Western, retired after forty years continuous service with the company. He began his railway career with the company as a freight brakeman in 1875. In 1891 he was appointed trainmaster at Milwaukee, Wis., and from 1893 to 1897 he was assistant superintendent at Milwaukee. In 1897 he was appointed superintendent at Winona and in 1901 he became assistant general superintendent. In July, 1902, he was appointed general superintendent, and in January, 1906, he was promoted to the position of assistant general manager and in November, 1910, he was general manager of the company's lines east of the Missouri river. Mr. Cantillon leaves the service of the company at his own request by reason of failing health, and it is earnestly hoped that a complete rest for a period will restore his usually excellent health.

Mr. Samuel G. Strickland has been appointed general manager of the Chicago & North Western lines east of the Missouri river. Mr. Strickland is a graduate of the Collegiate Institute at Port Hope, Ontario, Canada. He entered railway service in 1877 as a telegraph operator on the Canadian Pacific. From 1878 to 1880 he was operator and clerk

with the St. Paul, Minneapolis & Manitoba, now the Great Northern, and from 1880 to 1892 he served as telegrapher, clerk, agent and general agent with the Chicago, St. Paul, Minneapolis & Omaha. He was agent and superintendent of terminals for the same road at Minneapolis, Minn., for two years, and afterwards chief clerk to the general superintendent of that road. From 1890 to 1900 he was trainmaster and assistant superintendent; 1900 to 1905 superintendent at Omaha, Neb., and from 1905 to 1908 general superintendent at St. Paul, Minn. He was appointed assistant general superintendent of the Chicago & North Western at Chicago in 1908, and general superintendent, November, 1910, and since April, 1912, has been assistant general manager of the road. Mr. Strickland has thus reached his present position by a thorough long service experience, and has shown himself a thoroughly capable and efficient officer in every place that he has been called upon to occupy.

Mr. W. J. Towne, whose appointment as assistant general manager of the Chicago & North Western Ry. is announced, was born at Leavenworth, Kan., November 28, 1867. He was graduated from Rensselaer Polytechnic Institute, Troy, N. Y., in 1895. He had been with the Atchison, Topeka & Santa Fe Ry., from 1886 to 1891 as rodman instrumentman and assistant engineer. He was assistant engineer, New York State Canals from 1896 to 1899; 1899 to 1902, assistant engineer of construction of the Chicago & North Western Ry., at Boone, Iowa, at Kaukauna, Wis., and at Escanaba, Mich. Mr. Towne was made division engineer at Baraboo, Wis., in 1902, division engineer at Escanaba, Mich., in 1904 and from October, 1904, to 1906, was division engineer at Chicago. From March, 1906, to July, 1906, he was engineer of permanent improvements and from July, 1906, to April, 1912, engineer maintenance of way. Mr. Towne has been general superintendent since April 1, 1912.

Traveling Engineers' Convention.

Secretary Thompson, of the Traveling Engineers' Association, has sent out a very comprehensive circular giving particulars about the next convention which will be held in Hotel Sherman, Chicago, beginning on Tuesday, September 15. The circular contains valuable particulars about the rooms in the hotel which every one expecting to be present ought to be familiar with. If any person interested has failed to receive this circular, we advise him to apply to Mr. Thompson to furnish one without delay. We also advise all the people needing rooms to apply for them before the matter escapes their memory.

The address of Secretary Thompson is New York Central Car Shops, East Buffalo, N. Y.

The subjects to be discussed this year are as follows:

"Difficulties accompanying prevention of dense black smoke and its relation to cost of fuel and locomotive repairs"; Martin Whalen, chairman.

"Operation of all locomotives with a view of obtaining maximum efficiency at lowest cost"; J. R. Scott, chairman.

"Advantage to be derived from the use of mechanical stokers, considering (first) increased efficiency of the locomotive; (second) to increase the possibility of securing a higher type of candidates for the position of firemen; (third) the utilization of cheaper grades of fuel"; J. H. DeSalis, chairman.

"The care of locomotive brake equipment on line of road and at terminals; also, method of locating and reporting defects"; Geo. H. Wood, chairman.

"Advantage derived from the use of speed recorders and the influence of same on operating expense"; Fred Kerby, chairman.

"Practical chemistry of combustion"; A. G. Kinyon.

"Scientific train loading; tonnage rating. The best method to obtain maximum tonnage haul for the engine over the entire division, taking into consideration the grades at different points on the division"; O. S. Beyer, Jr.

A number of the committee reports are now in, which bear evidence of unusual pains having been taken in preparing them, assuring you of one of the best conventions in the history of the association, and our friends the supplymen are very much in evidence, assuring you of an exhibit of the highest educational order and the usual good time.

How Erie's Triple E Locomotive Was Designed.

A conversation which the writer had recently with that prince of locomotive designers, Mr. Samuel M. Vauclain, leads us to believe that there is considerable romance associated with the designing of a new type of locomotive. In the course of the conversation Mr. Vauclain remarked:

"The Erie Railroad made inquiry for a Mallet freight locomotive capable of developing a tractive effort of 160,000 pounds. Naturally such a locomotive of the Mallet type would have had low pressure cylinders of such great size that it would have been impossible to have shipped this locomotive over any line to reach the Erie Railroad without removing the low pressure cylinders. There would also have to be a very unusual construction and a very unusual weight per pair of driving wheels employed.

"It was suggested by Mr. Vauclain to Mr. Schlafge, the general superintendent of motive power, that a locomotive of the Triple E type would be most satisfactory and while the idea was novel to him, the design had previously been worked out to the satisfaction of the Baldwin Locomotive Works people, and had been patented. With Mr. Schlafge's permission to bring the matter before Mr. Underwood, the president, an interview was obtained and a lead pencil sketch of the locomotive submitted to him and before it was quite complete Mr. Underwood had placed an order for one locomotive. Upon the completion of the sketch and the conversation, Mr. Underwood kindly made the order three locomotives.

"It was represented to Mr. Underwood that this locomotive would carry in its design practically all the working parts and details of construction employed in his Mikado locomotives and which were giving such general satisfaction on his line. Therefore, all parts such as frames, driving wheels, driving boxes, connecting rods, cross heads, valve motion and things too numerous to mention are exact duplicates of his Mikado locomotives. This type of locomotive would never have been suggested, however, were it not for the fact that we are now able to feed a locomotive boiler any amount of coal up to its capacity to burn it by the use of the Street stoker, which works admirably and with very little attention or repair. Thus the human equation heretofore preventing the use of large power units has been overcome and it is the belief of Mr. Vauclain that we are just begining to enter the field of large power units for freight service of the trunk lines of this country. If it can be proven that we can operate locomotives of 150,000 pounds tractive effort, with the same engine crew as heretofore and with less physical exertion on the part of the fireman than with the locomotive of only 50,000 pounds tractive effort, it would appear reasonable that such units of power will be in demand, not only by the railroad companies but by the employes as well. You, of course, are aware that the larger the unit the less the power unit costs per thousand pounds of tractive effort."

One of Sir William Whyte's Jokes.

A Manitoba *Free Press* reporter discussed one day with the late Sir William Whyte the great number of claims preferred against the railway by reason of horses and cattle killed by trains. He remarked the peculiar fact that practically every animal killed figured in the claims as thoroughbred stock. "Do you know," said Sir William, "I have reached the conclusion that nothing in this country so improves live stock as crossing it with a C. P. R. locomotive."

M. C. B. & M. M. Conventions.

The Forty-eighth annual convention of the Master Car Builders' Association will be held at Atlantic City, N. J., June 10-12, and the forty-seventh annual convention of the American Railway Master Mechanics' Association will be held at Atlantic City, June 15-17. Mr. J. W. Taylor, Joint Secretary, Karpen Building, Chicago, Ill.

Atlantic City Gets 1914 Convention.

The 1914 convention committee of the American Electric Railway Association acting with the committee of the American Electric Railway Manufacturers' Association, has decided upon Atlantic City as the location for the 1914 convention of the association. The dates are October 12 to 16.

Removal.

The Prince-Groff Company, with plant at Camden, N. J., have moved their general offices to the Hudson Terminal, 50 Church street, New York. With the election of new officers a very active manufacturing and sales campaign will be carried forward on their railroad specialties: "Pressurlokd" water gauge systems, "Wedglok" track drilling system and "Kwikgrip" pipe wrenches. The officers are Sherman W. Prince, president; George N. Steinmetz, treasurer, and Clarence B. Groff, vice-president. Charles H. Spotts has been appointed sales manager of the company.

Brownhoist Tools.

It seems to have been a very short time ago that the most ingenious and skillful mechanics in railroad repair shops were kept busy inventing and repairing appliances used for handling material between the tools and the loading cars. Of late this arduous duty has been performed by tools supplied by the Brownhoist Company, of Cleveland, Ohio. Like all specialties these Brownhoist tools are in every way superior to the old shop-made product and can easily be obtained on order. We advise every shop foreman who reads this notice to send for illustrated catalogue J from the Brownhoist Company, Cleveland, Ohio.

Some good influence appears to be stirring the people connected with the operation of New York, New Haven & Hartford trains to endeavor to have their trains on time. On April 30 passenger service of that road made a new low record in trains late. Out of 2,021 trains only 97 or 4.8 per cent. were late. This is the lowest percentage of trains late since November 1, 1913. Out of the 97 trains late four were through trains.

Rivalry of Automobiles.

The automobile is becoming a serious competitor of railways in some parts of the world. Auto trucks that carry from ten to twenty tons of merchandise are to be seen carrying loads into nearly all large cities, their loads being the farm produce that was formerly carried by railroad trains. Every morning whole crowds of auto trucks are to be seen winding their way along the Long Island roads that lead to New York, a line of transportation which must seriously reduce the Long Island Railroad earnings.

This movement is not confined to the United States, all countries in Europe giving opportunities for developing automobile transportation. Italy, which has greatly increased its railway mileage of late years, is developing automobile public services to such a great extent that up to the end of last year in the sixty-nine provinces of the kingdom about 6,000,000 miles of roads were used by regular automobile lines subventioned by the State.

The province of Perugia came first, with over 450,000 miles of automobile lines, and that of Girgenti in Sicily last, with only two miles. Out of the sixty-nine provinces, eleven in northern and central Italy had no automobile lines at all. As a rule one can travel quite as fast and as cheaply by motor buses as by rail in Italy, and the motor services have a great advantage over railroads, that namely of reaching heretofore inaccessible towns and villages out of the beaten track.

Everything in Its Place.

Keep your tools handy and in good condition. This wise advice applies everywhere and in every place, from the smallest shop to the greatest mechanical establishment in the world. Every tool should have its exact place and should always be kept there when not in use.

Having a chest or receptacle with a lot of tools thrown in promiscuously is just as bad as putting the notes in an organ without regard to their proper place. If a man wants a wrench, chisel or hammer, it's somewhere in the box or chest, or somewhere else, and the search begins. Sometimes it is found, perhaps sharp, perhaps dull, perhaps broken, and by the time the workman finds the tool time enough to pay for several tools has been wasted.

The habit of throwing every tool down anywhere, and in any way or place, is one of the most detestable habits a young mechanic can possibly get into. It is only a matter of habit to correct this. Make an inflexible rule of your life to have "a place for everything and everything in its place."

Moses Hesitated.

Solomon and Moses, while walking by the canal, saw a notice-board which stated that five shillings would be paid to whoever rescued another man from drowning. It didn't take more than a minute to arrange that one should fall in and be saved by the other, and the "stakes" divided. In went Sol, and found it rather deeper than he expected. However, he splashed about, crying: "Come on, Moses! Save me!" Moses hesitated. "Sol," he said, "I've been reading that notice-board again, and it says, 'Ten shillings for a dead body.' Now, do be reasonable."

Effective Remedy.

A prominent physician was recently called to his telephone by a colored woman formerly in the service of his wife. In great agitation the woman told the physician that her youngest child was in a bad way. "What seems to be the trouble?" asked the doctor. "Doc, she swallowed a bottle of ink!" "I'll be over there in a short while to see her," said the doctor. "Have you done anything for her?" "I gave her three pieces o' blottin' paper, Doc," said the colored woman doubtfully.

He Blazed Away.

An Irishman who wasn't much of a hunter went out to hunt one day, and the first thing he saw to shoot at was a bird sitting saucily on the top of a fence. He blazed away, and then walked over to pick up the victim. What he happened to find there was a dead frog, which he raised carefully at arm's length, looking at it with a puzzled air. Finally he remarked: "Well, but ye was a deuce of a fine-looking burd befur Oi blew the fithers off o' ye!"

A Prudent Scot.

A friend caps the story with another of the prudent Scot, or rather of the prudent Scot's wife. They were at sea together—in the liberal sense—and had just left the dinner table. There was sufficient roll to produce internal uneasiness, and the husband was seen to be making progress to the side of the vessel, when his wife intervened. "Remember, John," she said, "you've just had your denner, and it's paid for." It was not lost.

Not Conscious of the Loss.

An old negro, taken ill, called in a physician of his own race. There being no signs of improvement he at last asked for a white doctor. The doctor came, felt the old man's pulse and examined his tongue. "Did your other doctor take your temperature?" he asked. "I don't know, sah," replied the negro; "I ain't missed anything but my watch so far."

President Mohler Dwells on his Forte.

Nearly every successful business man has peculiar to himself what Artemus Ward called his forte. Long acquaintance with Mr. A. L. Mohler, president of the Union Pacific Railroad, convinces the writer that Mr. Mohler's forte is the capacity for securing business. He rose steadily from clerk to general freight agent because he could secure business when others failed. The same power has lifted him to be president of one of our most important railroads.

Mr. Mohler thinks that the views and business fallacies entertained by the people of Nebraska has been proving ruinous to the State, and he has told them some plain truths that will do the community a world of good if properly digested.

"The railroads have created the facilities which represent part of your prosperity," said Mr. Mohler, "and are one of the developing influences in Western civilization; their property, their men and their officers are entitled to the same fair treatment that you extend to other respectable citizens and businesses of the city, county and State.

"Why are there not more people in Nebraska, which is so sparsely settled? The platform has been occupied by our traducers for the last ten years, until they have succeeded in discouraging investment in enterprises of our character.

"The tremendous increase in taxes, with the regulations which are covered by numerous State and Federal laws, all of which carry expense, and the discrediting of the sincerity of men in our profession, has resulted in a lack of confidence in what should be, aside from Government bonds, one of the most acceptable investments in this country.

"So long as these conditions exist and we are continually attacked by irresponsible people—I mean men, usually, who have no investment to imperil except their personal position—it cannot result in any other manner except to discourage development in the territory west of the Mississippi River. This territory could, under the right conditions, sustain 50,000 miles more of track at an investment of $2,000,000, offering employment to many people, adding to the value of the lands and the creation of taxes, and supporting many millions more people."

Defects Excluding Locomotives from Service.

The Canadian Board of Railway Commissioners issued a circular recently stating that at a meeting of representatives of the principal railways the following memorandum in regard to defects in locomotives was agreed upon:

Locomotives must not be allowed to leave terminals, or be used at terminals, in traffic service, on which any defects exist, as prescribed in the following list:

Steam leaks from any part of a locomotive which render it impossible for engineer to see signals in sufficient time to enable him to bring his train to a stop within the required distance.

Air brakes on locomotives or tenders not in serviceable condition.

Wheel defects. Locomotives with steel or steel tired leading engine truck wheels, leading or trailing driving wheels, or tender wheels with flanges worn 1-16 below M. C. B. wheel defect gauge for cars of less than 80,000 lbs. capacity or over.

Locomotives with cast iron engine truck wheels and cast iron wheels under tender weighing over 130,000 lbs. with flanges worn 1-16 below M. C. B. defect gauge for cars of 80,000 lbs. capacity or over.

Locomotives with cast iron wheels under tender weighing 130,000 lbs. or less with flanges worn 1-16 below M. C. B. defect gauge for cars of less than 80,000 lbs. capacity.

Locomotives with truck or tender wheels having shelled out or flat spots over 2½ ins. long or so numerous as to endanger the safety of the wheel.

Steel tires on locomotives worn hollow ⅜ in. in depth, or which are worn below safe limit of thickness. Railway companies to file with the commission their standard limit of thickness of tire, on all classes of locomotives, for approval.

Flat or shelled out spots on locomotive driving wheels 3 ins. long.

Springs. Locomotives with defective springs on any part of locomotive or tender which are unable to carry their respective weight when locomotive is standing.

The circular also asked railway companies to make by February 23, what, if any, objections they might have to the addition to the memorandum of the following clause:

"Railway companies are required to equip their locomotives with double windows in the front of the cabs during the winter season, November 1 to April 30, the same to be made air tight."

One Triumph of Observing Habits.

We are everywhere receiving new proofs that the faculty of observing things and making practical use of the knowledge gained from observation, is the most valuable attribute any person can possess. Nearly all great inventions have come from suggestions given to observing minds. This line of thought has been suggested by learning of the death of Augustus Stanwood, an event which has excited very little public notice, although an invention carried out by that man revolutionized the art of paper making.

Sixty years ago, in the woods of Maine, Augustus Stanwood followed his father's flocks and in doing so made intimate acquaintance with the fiery hornet and fell into the habit of tearing down all the nests he could find of that venomous insect. In following this line of boyhood industry, he came to observe that the material forming the nests had a strong resemblance to paper. This suggested closer observation. He stopped destroying the nests and proceeded to watch closely the method of construction followed by the insects. He found that the paper-like material forming the nests was made from wood pulp. To reproduce similar material became the ardent quest of the young man and after many failures he succeeded in making pulp paper.

Up to the discovery made by Stanwood, all the paper used was made of rags. In 1862 Stanwood built a pulp factory in Gardiner, Mass., and the place is still in operation.

The huge rolls of wood-pulp paper whose manufacture is one of the great industries of the country, the tons of paper whose purchase forms so large a share of the expenses of every printing establishment, that paper, which has for many years been a leading feature of tariff debate, which has occupied the attention of statesmen, and which, in newspaper, magazine and book production is the instrumentality of nearly all the information civilization possesses, dates from the date when Augustus Stanwood watched the hornets at their work—and pondered—tried to draw from the sight he saw its inner meaning and its possibilities.

New Branches of the U-S-L.

A new branch of the United States Light and Heating Company has been established in Washington, D. C., in the Evans Building, 1420 New York avenue, with Mr. W. G. Davis in charge. Mr. Davis, who was formerly connected with the U-S-L sales department at New York City, will have under his direction the sale of U-S-L storage batteries, electric starter and lighter, and axle electric car lighting equipment in this territory, which includes the States of Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware and part of Pennsylvania.

It may be added that the New York sales office and service station of the U. S. Light & Heating Company, formerly located at 210 West Fiftieth street, has been transferred to the Locomobile Building, at 16-24 West Sixty-first street, New York.

New Preserving Plant.

A tie preserving plant has been built at Reed City, Mich., to treat ties for the Grand Rapids & Indiana Railway. The capacity is 200,000 ties treated annually. Beech, birch and maple ties will be treated with zinc chloride and substituted for cedar and oak ties, which have largely been used in the past but are now becoming scarce or high in price.

RAILROAD NOTES.

The Union Pacific is in the market for 100 passenger cars.

The Illinois Central is reported in the market for 3,000 cars.

The Norfolk & Western has taken bids on steel for shop extensions at Roanoke, Va.

The Atlantic Coast Line will build a 40 stall brick roundhouse at Florence, S. C.

The Boston & Albany is said to be taking bids on 1,200 tons of steel for 18 bridges.

The Seaboard Air Line is in the market for 15 freight and 10 passenger locomotives.

The Chicago & North Western is still negotiating for thirty-five to forty locomotives.

The Denver & Rio Grande has ordered 500 gondolas from the Pressed Steel Car Company.

The Cuban Central is in the market for 45 box cars, 235 flat cars and 40 caboose cars.

The Lehigh & New England has ordered 9 cabooses from the American Car & Foundry Co.

The Ocean Shore has ordered two mogul locomotives from the Baldwin Locomotive Works.

The Mobile & Ohio has ordered seven consolidation locomotives from the American Locomotive Co.

The Missouri, Kansas & Texas has ordered five mikado locomotives from the American Locomotive Co.

The Cuban Central is said to be in the market for 13 ten-wheel locomotives and one consolidation locomotive.

The Chicago & Northwestern has ordered 3,000 40-ton box cars from the American Car & Foundry Co.

The Pekin-Mukden is said to have ordered two consolidation locomotives from the Baldwin Locomotive Works.

The Maryland & Pennsylvania has ordered two consolidation locomotives from the Baldwin Locomotive Works.

The Erie has ordered four passenger cars from the Standard Steel Car Co., and eight from the Pressed Steel Car Co.

The Erie has ordered 14,000 tons of rails, 12,000 tons going to the Carnegie Steel Co. and 2,000 tons to the Illinois Steel Co.

The Chicago, Milwaukee & St. Paul has placed an order for 2,000 tons of standard section rails with the Illinois Steel Co.

Delaware, Lackawanna & Western has placed orders for 500 steel hopper cars, but is still in the market for 200 automobile cars.

A turntable to cost $20,000 is under consideration by the New York Central for the Coffeen street roundhouse at Watertown, N. Y.

The St. Louis, Brownsville & Mexico Railway has placed an order for 15 consolidation locomotives from the Baldwin Locomotive Works.

The Delaware & Hudson has placed an order with the American Locomotive Co. for ten Pacific and fifteen consolidation locomotives, it is reported.

The Rutland, which was reported as having ordered eight passenger coaches from the American Car & Foundry Co., has increased its order to 25 cars.

The Delaware, Lackawanna & Western is in the market for two hundred 60,000-lb. capacity automobile cars and five hundred 50-ton steel hopper cars.

The Butte, Anaconda & Pacific has placed an order with the General Electric Co. for four eighty-ton electric locomotives, in addition to seventeen previously ordered.

Work on the new roundhouse of the Illinois Central, at Jackson, Miss., has been commenced. This road will construct three plate-girder bridges on its line between Fulton, Ky., and Memphis, Tenn.

The Great Northern plans the expenditure of about $2,000,000 on the line from Williston, N. D., to Cutbank, Mont., it is said. Eight new stations will be built besides extension of industrial tracks and construction of water softening plants.

The Louisville & Nashville has ordered 700 steel underframes from the Mt. Vernon Car Mfg. Co. and 700 steel underframes from the Pressed Steel Car Co. This road will build at its South Louisville shops 700 box cars, 100 40-ton stock, 100 40-ton flat and 500 50-ton gondola cars.

Safety Suction Devices for Punch Presses.

For some time the Westinghouse Electric & Manufacturing Company at east Pittsburgh tried mechanical safety devices of various kinds for the punch shop, but with unsatisfactory results. The operators found them unsuited because of the fact that they tended to retard the production, and consequently their earnings, while the management also objected to them because they afforded only partial protection, as the operator had to place his hand under the press in every instance, in order to remove the scrap.

The suction device illustrated herewith was developed with the idea of preventing the necessity of the operator approaching the danger point at any time during the operation, as he feeds and clears the press with the same tool.

Another advantageous point is that the operator does not take hold of the material with his hands (this applies principally to the smaller sizes), and thereby escapes the numerous small cuts to which he was subjected when inserting the blanks with his fingers.

SUCTION DEVICE FOR PUNCH PRESS.

The double handle device used on large work, and shown in illustration, is absolutely safe, the operator being compelled to use the device owing to the size of the sheets handled, it being impossible to get hold of the sheets any other way.

Before adopting this method a man was placed at the back of the press to feed in the sheets, and he was the man who most frequently was injured because his fingers were entirely at the mercy of the operator.

Since the adoption of the suction device there has not been an amputation on the large presses, and up to the present time no finger has been amputated in the punch shop. This freedom has been due to the operation of the devices, and the rigid enforcement of the rules by the management of the shop.

The suction device was exhibited and received the grand prize at the recent International Exposition of Safety and Sanitation in New York City, and is now on exhibition in the American Museum of Safety in New York City.

The Westinghouse Electric & Manufacturing Company also employs a number of other safety devices, such as magnetic lifters, sliding devices, etc., adapted for the different kinds of punchings made.

Making Markets.

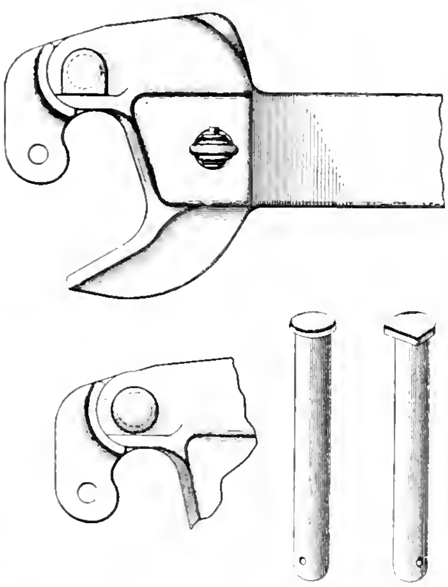
When the Standard Oil Company first went to China it found its sales limited by the fact that most persons had no suitable lamps, says the *Value World*. So the company had a lamp made for the burning of kerosene which it sold to the Chinese for seven and a half cents apiece. In the first year 875,000 lamps were sold, and in the year following 2,000,000. With lamps to burn the oil and give good light the company's kerosene sales climbed like the flight of a balloon. This lamp has enabled the toiling Chinese to add several hours to his work day, has promoted the business of the company, and has carried light in a very real sense into the dark places of the earth. Here we have an excellent example of the working of modern industry. It goes into the world looking for markets, and if it can not find them it makes them. Our railroads build into unpeopled territory, then bring in settlers, then carry out their produce. Factories produce a new food, then create a desire for it in divers alluring ways. You have no need for what we offer, says the up-to-date manufactner. Very well, we'll furnish you with a need, and straightway proceeds to do so. About ninety per cent. of modern salesmanship consists in persuading people to buy what they think they don't need and are not sure they want.

The Alaska Railway.

Now that the Government has decided to build the Alaska Railway, one of the first questions to be determined will be that of the selection of the engineer to lay out the best location for the road. The locating of a new line is the most important work that the engineering staff of a new railroad have to do. The locating engineer is a specialist. Upon his good judgment depends the question as to whether the completed road is to cost so many million dollars more or less; and in the selection of the man for this work, political considerations should have no weight whatever. If the Government wishes to show how well it can lay out, construct and equip a railroad, it should select its staff entirely upon their merits, that is to say, upon the work which they have done under conditions approaching those which will be met with in Alaska.

Improvement in Car-Couplers.

Mr. Robert E. L. Janney has secured a patent on an improvement in car-couplers, which is particularly applicable to couplers of the Janney type, having a coupler head, a pivoted knuckle and a locking member. The invention consists of a change in the head of the pin, as shown in the accompanying illustrations, and prevents the pin from turning round with the knuckle when the latter is swung to open and closed positions. There are a number of reasons that experience readily demonstrates that the turning of the pin should be avoided, and various devices have been used with success as long as the specially designed pin was used for the particular coupler, but as pins often become broken or lost, unless a similar pin was at hand the coupler and car were consequently placed out of service.



DETAILS OF IMPROVED CAR-COUPLER.

It will be noted that Mr. Janney's device takes the form of a D-head pin, for the reception of which the coupler is furnished with an upstanding flange or rib which is adapted to co-operate with the head of the pin to completely prevent the pin from turning, and at the same time the flange or rib is far enough removed from the longitudinal axis of the pin to permit the insertion of an ordinary round-headed pin such as are generally carried in the equipment of trains. A round-headed pin of course will not be prevented from turning, but will temporarily suit the purpose until the proper type of pin can be procured.

It may be added that it has been the custom heretofore to provide a D-head pin by tangentially shearing off a portion of the head of the ordinary round-headed pin, so that the straight portion of the head was parallel with the outer edge of the pin, and any projection on the knuckle to keep the pin in place precluded the possibility of the temporary use of the ordinary round-headed pin. The main feature in the improved device, therefore, is the furnishing of a pin with means preventing it from turning and at the same time leaving the knuckle in such condition that the common round-headed pin could be used if occasion required.

Wearing of Lampblack.

Lampblack is one of the most permanent pigments. It is composed principally of carbon, with usually a small percentage of mineral matter and moisture present. It has fairly remarkable covering and coloring properties, and it wears like the eternal truth. While it is not exactly jet black, having a gray, and, in some samples, a sooty appearance, it is, nevertheless, a color of strong individuality, and its use in connection with other pigments is considerable, and always to the benefit of the wearing properties of the mixture. No paint shop stock of supplies is complete without at least a small quantity of refined lampblack. The remarkable wearing properties of this black is attested in ancient burial places where grave markers, made of wood, and lettered with lampblack, show the wood actually worn away while the black letters, standing out as though carved from the timber, remain firm, distinct, and intact.

Cementing a Steam Chest.

The Chesapeake and Ohio Railroad Company have successfully used Portland cement for the temporary repair of a fissure, three inches long, in the steam chest of a locomotive engine. Cement was employed because the part affected was inaccessible for the customary treatment. It is stated that after having been in service for eight months, the locomotive was sent to the shops for general overhauling, when the cement lining was found to be so perfect that it was left in place.

Removing a Stubborn Nut.

Heat an open-end wrench that fits the nut, and while hot place it on the nut and allow it to remain for two or three minutes, says the *American Machinist*. The heat will cause the nut to expand and it can be taken off with ease. A heated wrench gives much better results than a blow torch, as the torch will heat the nut and bolt at the same time, where the hot wrench only heats the nut. Any nut which resists the hot wrench will probably have to be split to take it off.

The Southern Pacific has erected new shops at Houston, Tex. The erecting shop is 127 by 310 feet, built of reinforced concrete, equipped with one 150-ton traveling crane.

Books, Bulletins, Catalogues, Etc.

Standard Train Rule Examination.

The ninth edition of Standard Train Rule Examination, by G. E. Collingwood, author and publisher, 407 Crittenden avenue, Toledo, Ohio, has just been issued in a substantially bound, handy volume of nearly 200 pages. Price, postpaid, $2.00 Mr. Collingwood has long enjoyed the reputation of being the standard authority on train rules in America, and the present edition of his excellent work will be found to sustain, in an eminent degree, the position that he has earned. The book is specially adapted for the use of examining officials, and also for the use of trainmen, train dispatchers, telegraph operators and others who require to be thoroughly familiar with train rules. It brings out very clearly the vital points in each rule and imparts a full knowledge of the object to be obtained in practice. The questions are based upon the Standard Code in universal practice in America, and pains have been taken to make the meaning of each rule so plain that there can be no mistaking the meaning The popular favor with which the book has been received is the best proof of its meeting the requirements of he situation.

MacRae's Blue Book.

The 1914 issue of MacRae's Blue Book appears in enlarged form on account of having consolidated with The Railway Supply Index-Catalogue. The two books covered practically the same field, and it is a commendable piece of business enterprise on the part of MacRae's Blue Book Company to absorb the other publication and issue a consolidated book. It contains an alphabetical address section of 18,000 concerns doing business with the railroads; a classified material section showing under 8,000 headings the names and addresses of various manufacturers of material used in the construction and maintenance of a railroad. There is also a trade name section indexing the trade names of all articles used by railroads, so as to show the manufacturer's name and address, and a miscellaneous data section giving odds and ends of information extremely useful to railroad officials. There is also 100 pages devoted to the list prices of railroad material, and this section is kept up to date by sending out revised list prices as occasion warrants The publication is distributed free to all who are concerned with the purchasing or specifying of railway material and supplies. To others the price is ten dollars.

The Diesel Engine.

The Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo., has issued an illustrated catalogue of 112 pages, that is of particular interest to the engineering world. It may not be generally known that the first Diesel engine built in America was completed in St. Louis in September 1898. It developed sixty horse power in two cylinders, and from that time to the present the growth of the industry has been rapid with the result that the St. Louis plant to-day represents an investment of over one million dollars, and is equipped with every device and convenience for the proper handling of Diesel manufacture, according to the most approved modern practice. The catalogue presents forty installations in twenty-three States and the views of Diesel power plants and specific information concerning these installations are of real value to prospective purchasers. The adaptability of this remarkable type of engine is clearly shown from the fact that it is already in successful operation in fifty-eight different lines of industry in America. Copies of the catalogue may be had on application to the main office at St. Louis, Mo.

Electric Heaters.

The Gold Car Heating and Lighting Company, New York, have issued a new catalogue descriptive of the company's standard ventilated core electric heaters and thermostatic control. In the appliances for heating and automatically controlling the temperature of all types of railway cars, ticket offices, stations, automatic sprinkler valve shelters, ventilators and other devices relating to heating and ventilating the company has shown an intelligent enterprise that has met with a large measure of popular approval. The catalogue furnishes a brief but complete description of many of these products. The illustrations furnish proof of the amazing variety of designs on their appliances that are adapted to every conceivable location so that their presence may be said to be imperceptible to the common observers. The perforated metal casings are the perfection of mechanical elegance, while the temperatures tested in a hundred experiments are unvarying. The catalogue furnishes an amount of information on the various devices that renders it complete in its kind. Copies may be had on application at the Company's main office, Whitehall Building, New York.

Locomotive Appliances.

A variety of locomotive appliances are described in bulletin No. 97, issued by Harry Vissering & Company, Chicago. Among the appliances are the "Viloco" and "Leach Type" locomotive sanders; the "Viloco" and "Improved Gollman" bell ringer, and an interesting variety of other "Viloco" products.

Railway and Locomotive Engineering

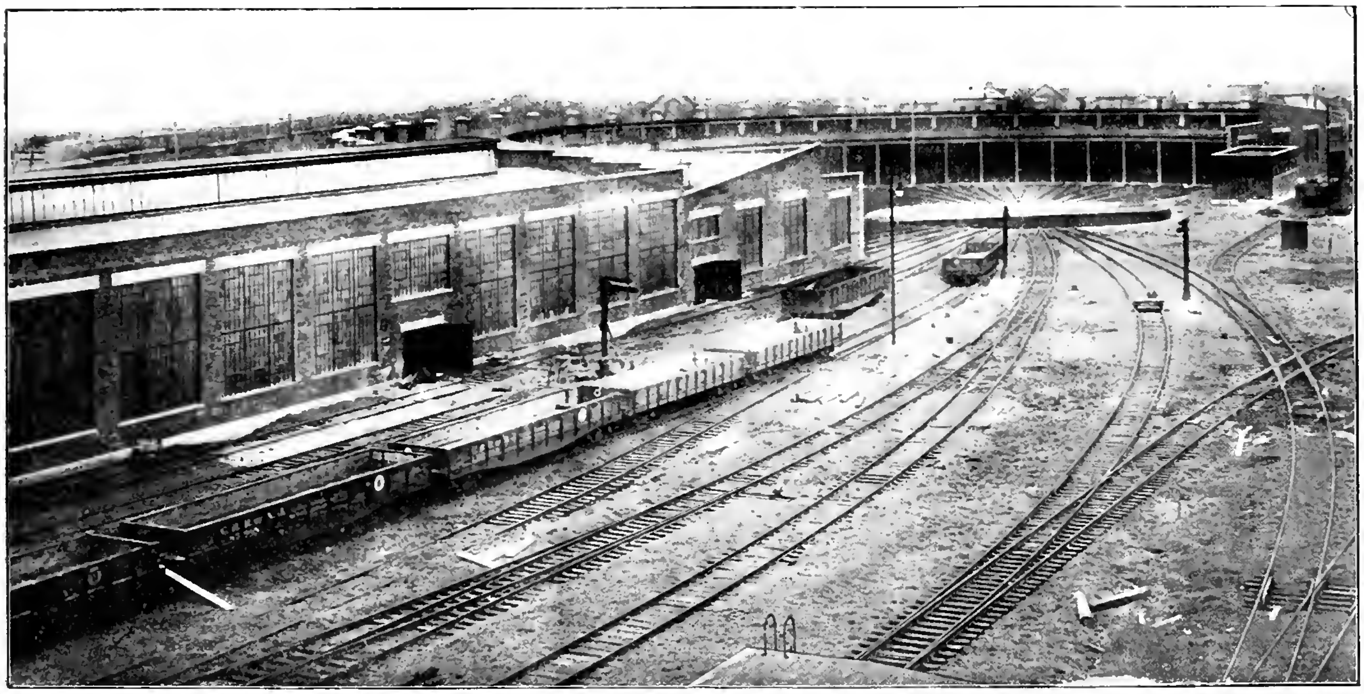
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, July, 1914. No. 7

New Locomotive Terminal

By reason of demand for increased facilities for rapidly and economically handling locomotives, The Central Railroad of New Jersey have had constructed for them at Communipaw, N. J., a modern Locomotive Terminal which for its size, convenience, and up-to-date construction is not excelled by any other plant in the country. The work was designed and executed by Westinghouse Church Kerr & Company, Engineers and Constructors, north side of the main tracks, and through which were handled 30,823 locomotives during the first four months of the present year, or an average of 255 locomotives per day. During the summer months the number of engines handled per day is about 300 which includes all the usual performances of cleaning fires, dumping ashes, coaling, supplying sand and water, washing boilers, and also inspecting, together with any light station, sand storage, roundhouse office and toilet building, engineers' locker building and telephone tower with all equipment and service inside of building and in yard.

The power house is 135 ft. long and 92 ft. wide with concrete boiler and machine foundations. The building proper is of brick with a structural steel frame for supporting boilers, stack, and coal bunkers; steel sash and doors.



NEW LOCOMOTIVE TERMINAL AT COMMUNIPAW, N. J., FOR THE CENTRAL RAILROAD OF NEW JERSEY.

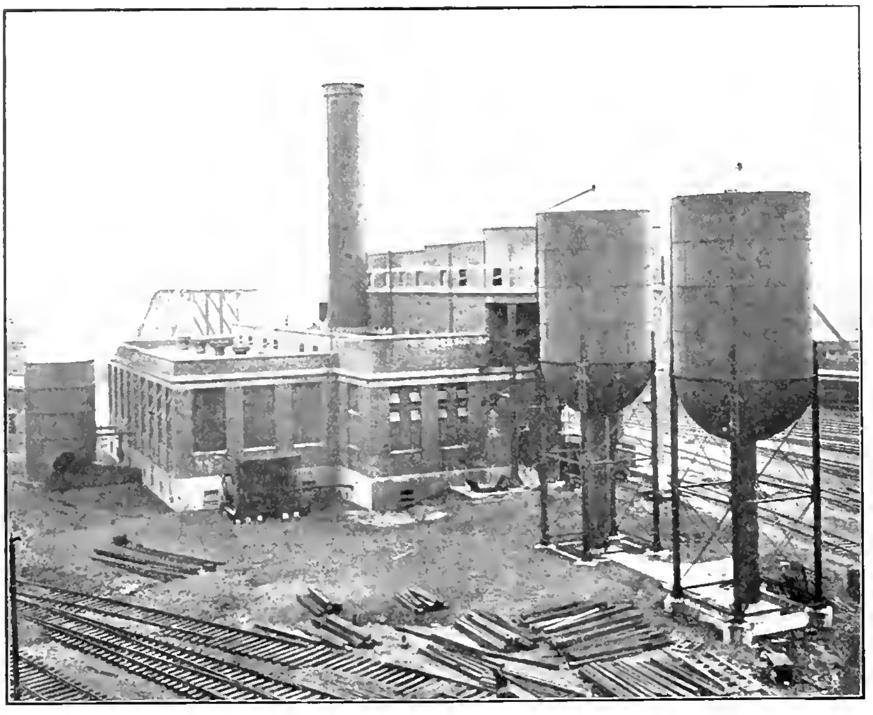
New York City, in co-operation with and under the direction of Mr. Joseph O. Osgood, Chief Engineer, and Mr. A. E. Owen, Prin. Asst. Engineer, of The Central Railroad Co. of New Jersey.

It has been possible to provide a layout of tracks, leading up and into the terminal, especially designed for the quick handling of passenger power, formerly cared for in the two old engine houses at Fiddlers and Communipaw, located on the running repairs that may be necessary.

These completed improvements consist of a power house to serve not only the engine terminal, but also to take care of all electrical requirements of the railroad from the Jersey City water front to Newark Bay. Two roundhouses, one 34-stall, 100-ft., and one 32-stall, 90-ft., two 100-ft. turntables, machine shop, blacksmith shop, storehouse and office, material platform, oil house, cinder pits, coaling

Six 250 h. p. B. & W. water tube boilers arranged in three batteries of two each are installed and space is provided for an additional battery. Boilers are fed by two reciprocating, duplex, outside end packed, plunger type pumps, either of which is capable of furnishing the maximum amount of water needed for the boiler plant. Stokers are installed. A lined steel stack 10' 6" in diameter and 75 ft. in height above the roof furnishes

natural draft aided by automatically controlled turbine type blowers. Feed water and steam piping are of the loop type. A Cochrane feed water heater provides feed water at a temperature of about 200 degs.


GENERAL VIEW OF POWER HOUSE.

Hopper bottom cars deliver coal into a track hopper. The coal is then elevated by bucket elevator, discharging into a flight conveyor which distributes the coal into the bunkers, located over the boiler room. The coal is fed by gravity to the stokers through chutes with gates operated from the boiler room floor.

Ashes are dumped from the stoker into a hopper directly underneath. The hopper terminates in a gate. A bucket on a car traveling on an industrial track is manually pushed underneath the hopper, loaded by gravity with ashes and then manually shoved to a point below an electrically driven hoist which elevates the bucket and automatically dumps it into a hopper above the railroad siding. Ash and coal handling arrangement is such that the railroad car is used to bring in coal and load with ashes without changing its position.

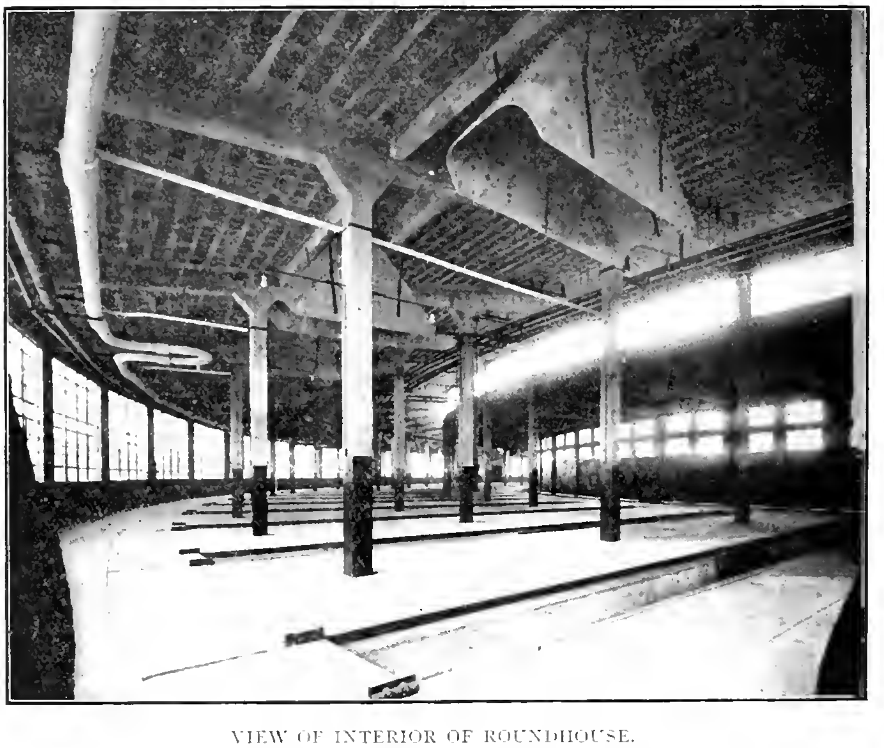
Three 600 kw. 2,200 volt a. c. General Electric turbo-generators are installed with space provided for a fourth unit. One steam driven exciter and one motor driven exciter are installed. Two 2,500 cu. ft. compound steam two stage air compressors furnish air for the engine terminal, also for operation of switches and signals in terminal yard between Communipaw and Jersey City and to Elizabethport and Newark on the main line and on Newark branch.

The roundhouses are constructed of reinforced concrete columns, piers, and roof girders with hollow tile and concrete roofs. The rear wall consists of concrete piers approximately 5 ft. wide with steel sash between, with an 8 in. brick wall below these windows. This arrangement permits a maximum window space both for lighting and ventilation. The roof line is broken at the first row of columns at the front of the building so as to give a row of hinged sash over each stall. Additional ventilation is provided for by means of three-chamber four-inch hollow tile set in the rear wall above the windows and in the locomotive door lintels. There are also ventilating openings above the sash in the roundhouse monitors. This arrangement follows The C. R. R. of N. J. standard practice and provides and outlet for any gases that may collect under the ceiling which is a flat arch giving an unobstructed path for gases to pass out through the ventilator openings. Both houses are heated by indirect system. The fans and heaters are located in the fan houses of which there are two in each house. The hot air is delivered through underground ducts and is discharged through outlets located in the pits and around the rear walls. The floor wearing surfaces are concrete throughout and are reinforced along the sides of the pits to provide bearing for jacking. Each house is provided with steam, air, and water service on columns.

In addition a boiler washing plant has been installed in connection with the 90 ft. house which serves 32 stalls. The piping is of such size as to permit of the system being extended to the 100 ft. house should it be desired at a later date.

Asbestos smoke jacks are at present installed, but the roofs of the houses are so designed and constructed that they could sustain the weight of cast iron jacks should it be found desirable to install them in place of the asbestos jacks.

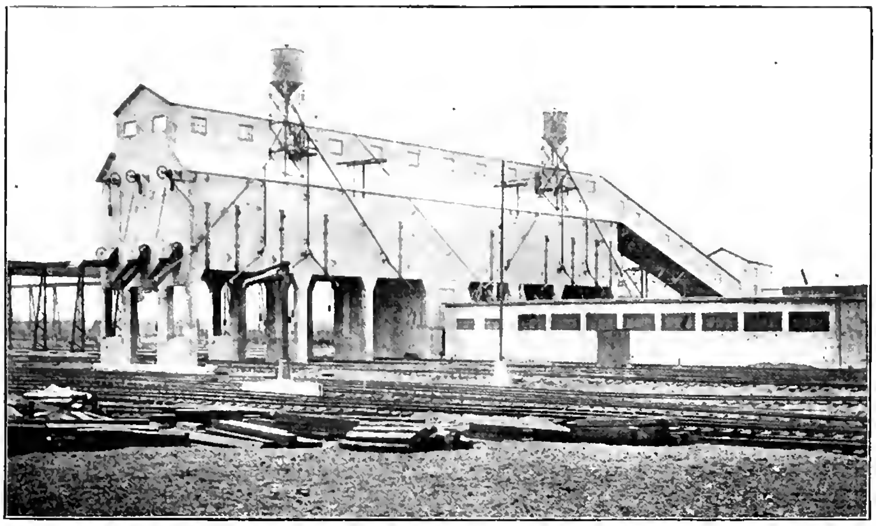
Both houses are lighted by Tungsten lamps, wires carried in conduits under floors and in columns. There is installed in the 90 ft. roundhouse one driver and truck drop pit and in the 100 ft. house two driver and one truck drop pit, each extending over three stalls which have pneumatic jacks for wheels and a one-half


VIEW OF INTERIOR OF ROUNDHOUSE.

ton crane for handling driver boxes, etc.

Each roundhouse is served with 100 ft. deck turntable of heavy construction operated by electric tractors.

Adjoining and directly connected to the 100 ft. roundhouse is a machine and blacksmith shop building. The total length is 200 ft. and the total width 80 ft. and the height is 28 ft. over all.



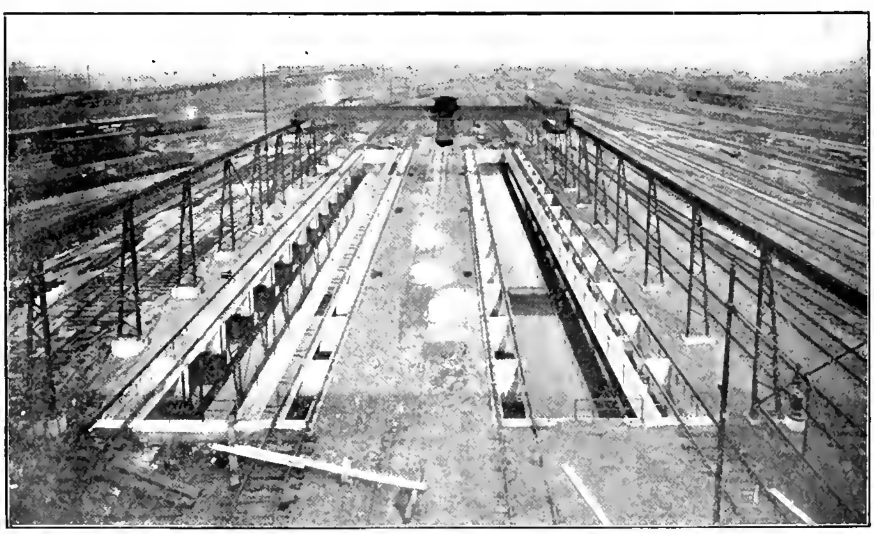
VIEW OF COALING STATION.

A monitor 13 ft. wide extends over the entire length of the building and is provided with continuous top hung steel sash operated from the machine shop floor. The machine shop space is 140 ft. long by 80 ft. wide and has a concrete floor throughout. The equipment consists of small lathes, crank planers, and other similar machines as may be required for light running repairs. Two motor driven line shafts near the north wall furnish power for the small machines. A motor driven wheel lathe for driving and truck wheel work is located near the center of the building and is served by 4 ton over head trolley. One of the roundhouse tracks is extended through the machine shop into the blacksmith shop. In the southeast corner of the machine shop space is provided for pipe. Besides two pipe forges this space contains an 8 in. pipe machine, pipe racks, benches, etc.

The blacksmith and boiler shop is located at the east end of the building and is separated from the main or machine shop by a fireproof wall. This space is 40 ft. wide and 80 ft. long and the south half is occupied by the blacksmith shop which is equipped with five down draft forges, each served by a half ton gib crane. A 2,000 lb. steam hammer served by a 3 ton gib crane is located in the center of the blacksmith shop space. The equipment of the boiler shop consists of motor driven punch and shears, hand bending rolls, flange fire and screw flanger.

The storehouse is 100 ft. long and 60 ft. wide and directly adjoins the blacksmith shop building. Its construction is fireproof throughout. Steel bins and counters are used for storing material, so that except for any combustible contents the fire hazard is reduced to a minimum. The easterly end of the building is divided by fireproof partitions into offices for the general foreman and the storekeeper and the toilet and wash room. The material platform is 48 ft. wide and 80 ft. long and extends 12 ft. in width along the north side of the storehouse. This structure is built of reinforced concrete and hollow tile with concrete wearing surface.

For the storage of various kinds of oil used at the engine terminal an oil house



VIEW OF CINDER PITS.

is located at the extreme east end of the material platform. This building is 20 ft. wide, 48 ft. long and one story in height and is provided with a basement 10 ft. high in which the various oil storage tanks are located.

The most interesting structure of the group on account of its size and construction is the coaling station. The main building spans 8 tracks and serves an additional track at each end. The structure is 168 ft. long, 34 ft. wide, and 55 ft. high and is of reinforced concrete throughout. The bunkers rest on special steel I beams, girders encased in concrete and the hopper bottoms are built of reinforced concrete with hollow tile. The sides of the bunkers are heavily reinforced to withstand the side pressure of the coal when the bunkers are filled. A monitor extending the full length of the structure is of steel trusses with 2 inch plastered concrete sides and is provided with an asbestos roof. The coal is received from the cars by two receiving hoppers from which it is discharged by means of reciprocating feeders into bucket conveying elevators. These conveying elevators carry the coal to the top of the hopper house where it is discharged on two 30 inch belt conveyors running up the conveyor bridge over the top of the bunkers. Traveling trippers running on rails above the bunkers discharge the coal into various compartments.

There are three longitudinal bunkers having a capacity respectively of 430 tons of bituminous, 813 tons of broken, and 430 tons of buckwheat coal. These bunkers are each divided into four compartments by transverse concrete partitions. Each track is served by three coal chutes so that an engine on any one of the ten tracks may be coaled with either bituminous, broken, or buckwheat coal. The conveying machinery is divided into two separate and distinct units from the track hopper to the tripper over the bunker. Each unit having a conveying capacity of 100 tons per hour.

West of the coaling station and south of the machine shop and storehouse are the coal storage tracks having a capacity of 40 cars. Provisions are made for thawing out frozen coal in the cars on these tracks by means of live steam.

Provisions for the storing and drying of sand are made in a building west of

the coaling plant This building is of reinforced concrete throughout and is 103 ft. long, 16 ft. wide, and 14 ft. high. The green sand is dried by means of two coal stoves of standard Central R. R. Co. of N. J. design located in a separate room in the east end of the building. The dried sand is then screened and elevated by means of compressed air to two storage tanks of 15 cu. yds. capacity, each located on top of the coaling station. From these tanks the sand is delivered to the locomotive through castiron delivery pipes and wrought iron telescoping spouts serving each of the ten tracks.

The cinder pits are located about 60 ft. east of the coaling plant and are of the submerged type. They are each 200 ft. long, 30 ft. wide and 12 ft. deep and are heavy reinforced concrete throughout. Each pit serves two tracks which are 26 ft. center to center, the pits are parallel and are about 58 ft. center to center with a track for cinder cars between. The cinders are cleaned out of the pits by a four ton electric traveling crane operating a one and five-eighths yard clam shell bucket. This crane is located on a steel runway 240 ft. long, 99 ft. 6 in. span and 26 ft. above the rail. Aside from the economy and speed in handling engines over the pit this arrangement permits of the coaling of engines from cars by means of the clam shell bucket, should occasion arise.

The water piping is divided into two systems. The supply is taken from a 16 inch water main of the Jersey City water service and is discharged by city pressure through altitude valves into two 100,000 gal. steel elevated tanks and then through the low or service system of pipping to eight water columns in the yard for filling engine tanks and also into the buildings for general use.

Panama-Pacific International Exposition.

Great difficulty in handling the transportation of exhibits experienced at almost every exposition held in the past and for a time manufacturers and intending exhibitors were inclined to believe that a similar state of affairs would exist to a greater degree at the Panama-Pacific International Exposition, owing to the fact that the great celebration will be held in San Francisco, the metropolis of the Pacific coast and far removed from the center of America's greatest industrial activities. To the contrary, however, the facilities for handling the millions of pounds of exhibits are far better at the Panama-Pacific exposition than has ever been the case before. This will be true because of the fact that fully three years before the opening the most noted authorities on transportation entered into consultation on the subject and devised a system by which the exhibits might be handled perfectly without any derangement of the ordinary traffic.

It is expected that thousands of freight trains will be despatched to San Francisco loaded with exhibits, and each of these will be shunted off onto the exposition's own private line of railways at the terminal. The exhibition has constructed its own system of railways which covers every part of the 635 acres of the site and upon the arrival of a train loaded with exhibits will be "sided" onto this system and the freight cars hauled directly into the exhibit palaces for which the display is intended. Rails have been laid inside the building so that it will be possible to have the car unloaded on the very spot which the exhibit will occupy.

American Locomotives Win.

The commonwealth government of Australia has recently placed an order for four Baldwin locomotives for the Transcontinental Railway. This action caused serious debate in the Federal Parliament, and brought forth the following statement from the Assistant Minister of Home Affairs:

"Every manufacturer of engines in Australia was approached, to ascertain if they could be supplied in Australia. Without exception, the firms replied that they could not give speedy delivery. He then decided to invite quotations for quick supply from over-sea firms. The Baldwin Co., of America, made the most satisfactory offer.

"The price of the Clyde Engineering Co. for engines of this type was $30,148, but these American engines were costing $23,573 at Port Augusta, or $25,305 at Kalgoorlie; the question of price, however, did not enter into the case. The need for speedy delivery is that for every 50 miles of track laid an engine is required, and the tracklayers are putting down 1½ miles a day, so that a locomotive is required at each end of the railway every 2½ months. Inquiries were made of over-sea firms doing business in Australia, and the representatives of Baldwin's offered to ship the engines from the United States in 15 weeks. British and Scottish firms wanted 11 or 12 months.

Canadian Railway Accidents.

The Board of Railroad Commissioners for Canada report that last year there were on all the Canadian railways 2,547 accidents reported to the Board, involving the death of 643 persons and injury to 2,231. There were 21 passengers killed and 410 injured, 303 employees killed and 1,603 injured, and 319 "other persons" killed and 218 injured. Three passengers were killed and 218 injured, and 16 employees killed and 96 injured by derailments, and 3 passengers were killed and 117 injured and 46 employees killed and 136 injured in collisions. The Board held enquiries into 621 accidents involving the death of 277 persons and injury to 865. The report says: "Inquiries into derailments have brought out the fact that track conditions are largely responsible for such accidents. This is mostly accounted for by the fact that railway companies have not, on the whole, increased the efficiency of their road beds proportionately with the increases in the weight of their rolling stock." As to collisions it is said: "At first thought it would seem almost imperative that railway companies should be required to adopt, without undue delay, some form of positive block system on all lines. But we must not lose sight of the very important fact that the great majority of such accidents result from the non-observance of operating rules."

A Flying Train.

Much interest is being manifested by engineers and government officials in a "levitated" railway, a working model of which was recently exhibited in London, England. The motive power is electricity, though the application, in a commercial sense at least, is quite new. It has been known for years that certain kinds of currents have a repelling force upon certain metals, and it is this force which Emile Bachelet, the inventor, has made use of.

The model consists of a miniature car weighing some 40 pounds, constructed of steel with an aluminum base, resting upon about 30 feet of special track. Beneath the rails are electric coils which, it is explained, when energized by an alternating current, exercise a repelling effect upon the car sufficient to raise it a fraction of an inch above the rails. When thus suspended in the air, the car is drawn along by electromagnets, or solenoids, which span the track in the form of arches, through which the car passes. Although the model is raised above the track, four brushes attached to the car remain in contact with the rails and two other brushes make contact with an overhead grooved rail.

The system is operated by an ordinary switchboard, through which the currents are directed at the will of the operator. The secret of the invention appears to lie in the ability of the operator to cut off or break the wave of electrical energy at precisely the point at which it has greatest force.

Another Idea on the Alton.

Among President Bierd's new ideas on the Alton is a closer grading for box cars, to the end that only those entirely fit for grain loading shall be given that duty. This change, plus a careful overhauling, is expected to cut down the heavy expense of grain losses.

Mikado 2-8-2 Type Locomotive for the Illinois Central

One of the most notable orders for locomotives thus far placed this year has recently been filled by the Baldwin Locomotive Works for the Illinois Central R. R. Company. This order called for fifty freight locomotives of the Mikado type, increasing the total number of Baldwin engines of this pattern, in service on the Illinois Central, to 200. These locomotives have replaced Consolidation type engines using saturated steam, and under the efficient management of Mr. R. W. Bell, general superintendent of motive power, are hauling 30 per cent. more tonnage per train with no increase in actual coal consumption per trip.

There has thus been developed, by co-operation on the part of the railway company and builder, a most satisfactory design of heavy freight locomotive, which represents advanced practice, but does not incorporate any radically new or untried features. At the same time all these engines have a large number of interchangeable parts, an important factor in reducing the cost of maintenance.

These locomotives exert a tractive force of 51,700 lbs., and with 218,300 lbs. on driving wheels the ratio of adhesion is 4.22. Full advantage has been taken of the opportunity afforded by the Mikado type to provide liberal steaming capacity; and the boiler is of sufficient size to furnish all the steam needed for heavy duty.

The boiler has a straight top, and its center is placed 9 ft. 11½ ins. above the rail. It is designed for a pressure of 200 lbs. per sq. in., but in service the safety valves are set at 175 lbs. The longitudinal seams have diamond welt strips. Both the main and auxiliary domes are on the third ring. Here the seam is on the top center line, and it is welded and further reinforced by a large inside liner. The main dome is of pressed steel, in one piece, measuring 33 ins. in diameter and 20 ins. in height. The firebox has a deep throat, the distance from the underside of the shell to the bottom of the mud ring being 27 ins. The equipment includes a security arch supported on four water tubes, also four smoke-burner jets on each side of the firebox. These are arranged to draw air through 2-in. tubes which are placed in the side water legs. The superheater is of the Schmidt type, with 36 elements, and it is arranged with outside steam pipes.

The main frames are open hearth annealed steel castings, 4½ ins. wide. They are braced by the guide yoke and valve motion bearer, and also by a broad tie which spans the upper rails between the third and fourth pairs of driving wheels, and supports a boiler waist sheet. The main and rear pedestals are also braced by ties which extend the full depth of the pedestal legs. The front rails are double, and they are bolted and keyed to the main frames; while the rear frames are spliced to the main sections by a slab fit, immediately back of the rear driving pedestals. The rear truck is of the Hodges pattern, which has been used on all the Illinois Central Mikado type locomotives.

The steam distribution is controlled by 15-in. piston valves, set with a lead of ¼ in. The valve motion is of the Walschaerts type, controlled by the Ragonnet power reverse mechanism. All the valve motion pins work in bushings of hard brass. Hunt-Spiller metal is used for cylinder and steam chest bushings, pistons, piston and valve packing rings, and cross-head shoes. The cross-head keys are of chrome-vanadium steel.

The tender has capacity for 9,000 gallons of water and 15 tons of coal. The tender frame and truck side frames are of cast steel. The truck springs are double elliptic, of vanadium steel, and the tender and front engine truck wheels are of forged and rolled steel, manufactured by the Standard Steel Works Company.

The following are the principal dimensions of these locomotives:

Gauge, 4 ft. 8½ ins.; cylinders, 27 ins. x 30 ins.; valves, piston, 15 ins. diameter.

Boiler.—Type, straight; diameter, 82 ins.; thickness of sheet, ¾ in.; working pressure, 175 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 120⅝ ins.; width, 84 ins.; depth, front, 87¼ ins.; depth, back, 74 ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water Space.—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Material, steel; diameter, 5⅜ ins. x 2 ins.; thickness, 5⅜ ins., No. 9 W. G.; 2 ins., 0.125 in.; number, 5⅜ ins., 36; 2 ins., 262; length, 20 ft. 6 ins.

Heating Surface.—Firebox, 240 sq. ft.; tubes, 3,834 sq. ft.; firebrick tubes, 32 sq. ft.; total, 4,106 sq. ft.; grate area, 70.4 sq. ft.

Driving Wheels.—Diameter, outside, 63 ins.; center, 56 ins.; journals, 11 ins. x 12 ins.

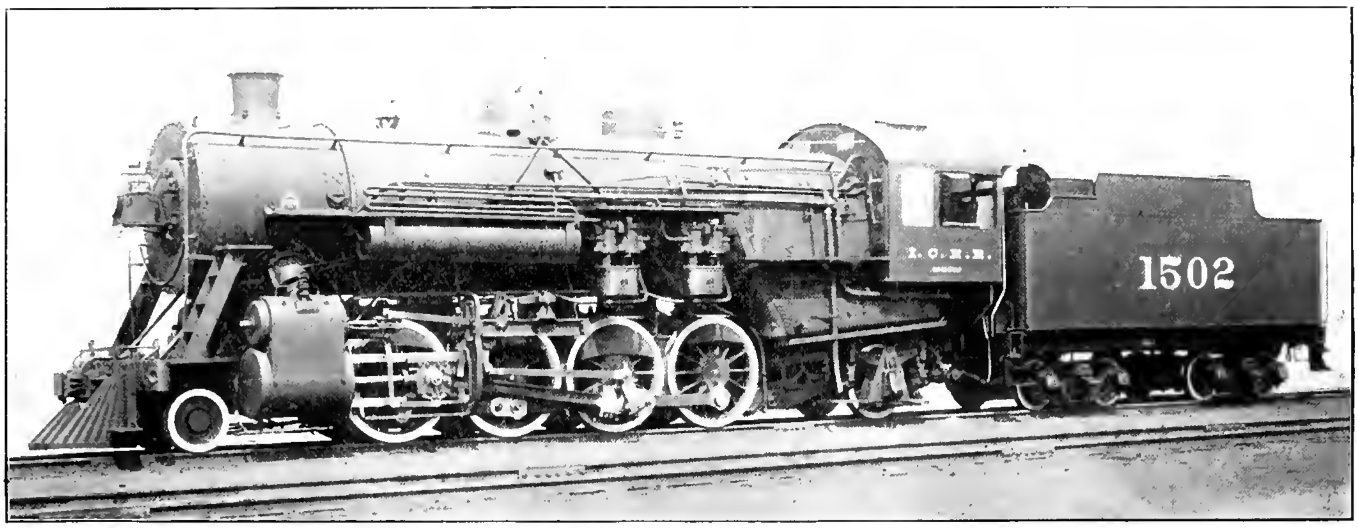
Engine Truck Wheels.—Diameter, front, 30½ ins.; journals, 6 ins. x 12 ins.; diameter, back, 45 ins.; journals, 8 ins. x 14 ins.

Wheel Base.—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total engine, 35 ft. 2 ins.; total engine and tender, 65 ft. 6¼ ins.

Weight.—On driving wheels, 218,300 lbs.; on truck, front, 26,300 lbs.; back, 38,100 lbs.; total engine, 282,700 lbs.; total engine and tender, about 455,000 lbs.

Tender.—Wheels, number, 8; diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 9,000 gallons; fuel, 15 tons; service, freight.

Engine equipped with Schmidt Superheater. Superheating surface, 887 sq. ft.



MIKADO 2-8-2 TYPE LOCOMOTIVE FOR THE ILLINOIS CENTRAL RAILROAD.

R. W. Bell, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

General Correspondence

Three Cylinder Locomotives.

EDITOR:

Your correspondent, whose communication entitled "Three Cylinder Locomotives," appears on page 204 and 205 of your June issue, is *inaccurate* in stating that "several misstatements" appear in extracts, made in your editorial article in your May issue, from my paper on the same subject which was read before the 1913 convention of the Master Mechanics' Association. The Standard Dictionary defines a "misstatement," as "a wrong or false statement," and "several," as "an indefinite number, more than one or two, yet not large." Your correspondent does not point out, nor am I able to find, even *one* statement in your extracts from my paper which is either "wrong" or "false."

The charges of "misstatement" are, as I understand the communication, your editorial statements, first, that "100 odd passenger engines of this [Webb] type were built from 1880 (not 1893) to 1899," and, second, that "In no case has this form of engine [three cylinder] established itself as a recognized class for any company." Neither of these statements was made in my paper, and your editorial does not contain any "extract" therefrom in which either of them appears. My paper stated (paragraph 17, page 257, Proceedings of 1913) that "Between 1893 and 1899, Mr. Webb built upwards of 100 three cylinder locomotives of the 0-8-0 type," and previously mentioned over one hundred *passenger* engines of the Webb type. The statement of your editorial (which, however, was not an "extract" from my paper), that "between 1893 and 1899" Webb built over 100 three-cylinder compound locomotives," is neither "wrong" nor "false," and does not therefore constitute a "misstatement," either on your part or mine.

My paper stated (paragraph 25) that 60 three-cylinder locomotives had been constructed for the Jura Simplon Railway, and (paragraph 27), that "in 1901 and thereafter, a number of three cylinder locomotives of the 4-4-0 type were put in service on the Midland Railway, England," and there is no statement whatever in the paper, or in any extract made from it in your editorial article of May last, to the effect that the type has not "established itself as a recognized class for any company." It manifestly has done so in Europe, and in view of the unquestionable advantages of the type, I am unable to understand why it has not been generally adopted in the United States.

J. SNOWDEN BELL.

New York, N. Y.

Effect of Lengthening Exhaust Cavity of Equalizing Slide Valve.

EDITOR:

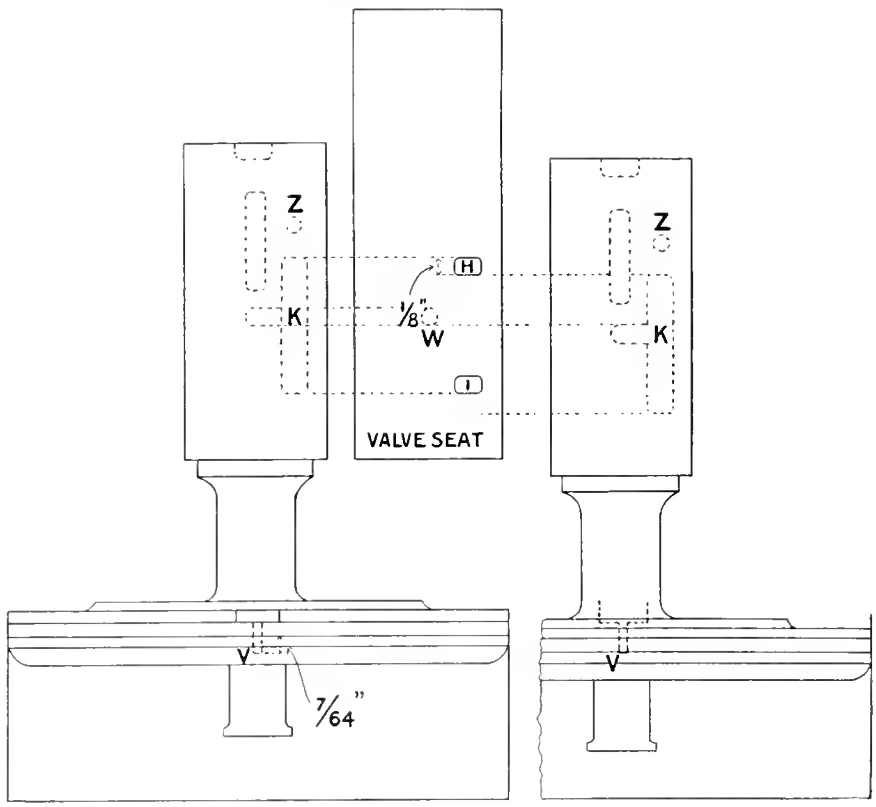
Referring to Mr. Hahn's article on "Brake Creeping On" in your June issue, I would say that in my opinion it would be a mistake to lengthen port "K," because by doing so would be a roundabout way of overcoming what might be accomplished more easily in another way.

First of all, as the accompanying illustrations will show, that application cylinder port "H" is 1/8 of an inch in width, and that portion of cavity "V" between the edge of the ring and the end of the groove is only 7-64 inch in length, leaving 1-64 of an inch in favor of ports "H" and "W," which must open before the edge of the ring passes the end of the cavity ("V").

The above measurements were obtained by smearing the valve, seat and bushing with a light coat of lampblack grease, and then taking the impression of the ports on paper, carefully measuring them by the aid of scale and dividers.

Probably Mr. Hahn's bushing groove (port "V") was lengthened by faulty cleaning methods at some previous time, or perhaps the opening in his packing ring came directly in line with the feed groove, thus allowing the pressure chamber to charge while the release ports remained closed.

The result of a test of two No. 6 valves on the Boston & Maine R. R. showed this: Valve No. 1—After making a ten-pound reduction the valve handle was returned to a point between "lap" and "running" so as to produce a rise in brake pipe pressure of about five pounds per minute. The equalizing piston and valve remained in the same position ("lap after service"), and the pressure chamber charged through the opening in the ring, leaving the ports "H" and "W" covered and the brake applied.



EFFECT OF LENGTHENING EXHAUST CAVITY OF EQUALIZING SLIDE VALVE.

The movement of the piston was obtained by the use of a special apparatus, consisting of a piston 1/8 inch in diameter fastened to the knob of the slide valve piston, the end protruding through a cap nut, suitably packed to prevent loss of air. The leakage past the piston ring was obtained by drawing the air entirely out of the brake pipe and pressure chamber, blocking the piston about half way in the cylinders, then making a light application with the independent valve. A lighted torch then showed the amount of leakage past the piston.

Test of Valve No. 2—With the above mentioned plunger applied to the piston end a ten pound reduction was made as

in the former case, but this time the brake valve handle was brought back far enough to produce a 2½ pound per minute rise in brake pipe pressure. When fully charged by the cab gauge the valve was moved to "running" position, and the brake released. Five similar trials failed to hold the equalizing slide valve covering the ports in order to keep the brake applied. Examination of the ring in the before-mentioned manner showed a very slight leakage, the ring ends together, and producing an almost perfect fit of the ring.

Comparison of these two tests show that with a valve in good condition, ring well fitted, bushing lubricated with a few drops of valve oil, slide valve perfectly dry or lubricated with dry graphite, that it will not be necessary to tamper with cavity "K" as the release is positive once the valve commences to move.

Another point is this: Lengthening port K 5-32 or even 5-64 of an inch would leave the space between ports "K" and "Z" so close together that it would be possible with a poor working valve like No. 1 to have ports "K" and "Z" in communication with port "H" at the same time, and with port "K" slightly open, and port "Z" with a larger opening, "the valve being stopped in this position," a light fluctuation in brake pipe pressure would set the brake simply by moving the piston and graduating valve. This could not happen if the piston and valve had traveled to their proper position (as in valve No. 2) because port "Z" would not be in communication with port "H." A slight blow at the preliminary exhaust port in the automatic brake valve would occur at this time, also because air from port "Z" would flow through release port "I."

Mr. Hahn also states that after the brake leaks on that it is no use to release them with the independent valve because they will creep on again, but fails to state where the air comes from that causes this. As the application cylinder is entirely drained by placing the independent valve in full release, the air that leaks back into the cylinder must come from a defective slide valve, rotary seat or gasket, or from the pressure chamber itself caused by a brake pipe leak moving the piston and slide valves. This last disorder is generally caused by a sluggish feed valve.

Thus, summing up these points, will show that with a well kept equalizing slide valve and piston, properly lubricated, with a feed valve in good condition, and by proper handling the necessity of lengthening cavity "K" will be eliminated. The illustration will show that in releasing after an automatic reduction it is impossible to open the feed groove "V" without opening the part "H," "I" and "W," thus releasing. If the piston should stop here with port "K" lengthened, port "H" (application cylinder air) only would be relieved, holding air in ports "W" and "I" to safety valve (not shown) trapped.

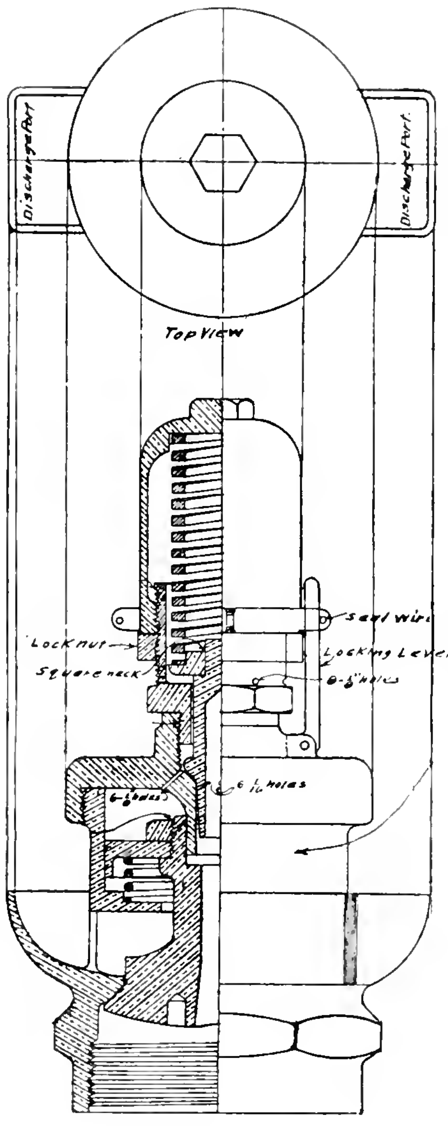
JOHN S. QUINN.

Malden, Mass.

Old-Fashioned Pop Valve.

EDITOR:

It is always interesting to look back at the relics of other years when the locomotives were perhaps not one third of their present proportions, but in their own way and in their work were probably as effective as they are in regard to the work which they are expected to do to-day. In regard to the smaller details it will be found that many of the modern improvements are not so radical after all, but rather an adaptation of old ideas to new conditions.



OLD-FASHIONED POP VALVE.

The accompanying drawing shows the details of what was known as the Taylor and Cole pop valve, which may be of interest to your readers. The drawing is made from an actual valve. It was one of a large number that had seen long service on the locomotives of the Cumberland and Pennsylvania railroad in Alleghany county, Maryland. On the valve casing the dates are cast showing that patents were secured on the contrivance in 1867, and also in June and November, 1869.

WM B. RAINSFORD.

Indian Head, Md.

Ignorance Concerning Air Brakes.

EDITOR:

I have been a constant reader of RAILWAY AND LOCOMOTIVE ENGINEERING and have always had a keen interest in the Air Brake Department that you publish each month. By its aid I have been able to keep abreast with the constant changes and improvements that are being made in the air brake apparatus. To my mind many of the roads in the southeast do not keep up with the improvements in air brakes, nor are the employees properly posted in the handling of the air brake. The Federal law requires that the freight train must not leave a terminal with less than 85% of the brakes in working order. But it is not uncommon to see a brake in which the piston will travel the full stroke and not press the shoes against the wheels. Piston travel is one of the most important things in train braking. How many car inspectors pay any attention to this important matter? Another defect that is very common is leaky train lines. A tight train line is a lost art since the cross-compound or two 9½-in. pumps have been placed on engines. It is said that with a tight train line the pumps will have nothing to do. I also notice that we have a good deal of trouble of late on account of leaks caused by long couplings pulling the hose loose enough to leak and stick brakes. It is rare to see a freight train with a tight train line these days, and a good stop with a leaky train line is an accident.

Train men as a general rule are not posted and in some cases do not even understand the principle of a brake and are sometimes very indifferent in regard to leaks and other defects, often cutting out a good brake because a cross-over pipe union was leaky when the union could be tightened; but, who ever saw a brakeman carry a monkey-wrench? I have seen many triples cut out because they would not release as soon as other brakes on the head end of the train and would not bleed off. I have noticed on long, heavy steel passenger trains that the brakes are very rough at times and beyond the power of the engineer, but he gets criticised by the public who know little and care less as to the reason for the rough stop. I happened to be on one of the cars of a twelve-car all-steel train, made up of several different kinds of cars and brake equipment and was in the eighth car. When the train stopped, everybody stood up. One passenger was

very loud in his praise of the engineer and the railroad company for allowing him to run an engine, and it was a good thing for the engineer that he was eight cars ahead. I looked under the car and saw that the trouble was caused by a quick-action triple on that car and a slack adjuster that would not work and about a 12-in. piston travel on that car. The car ahead had a P. C. valve in good shape, and also the one behind, and when the brakes were applied there was some cutting up by that car, but the engineer got the blame. The railway company should see that more attention is paid to the remedy of the defects mentioned and should encourage employees that come in contact with the air brake equipment to learn the principle of the same.

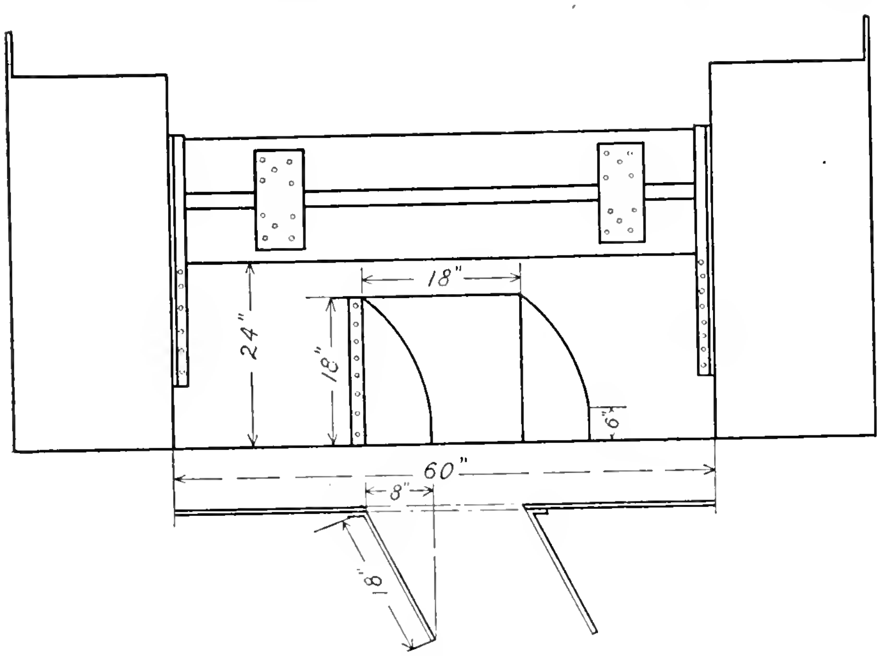
J. F. Heyser,

Macon, Ga.

A Coal Saver.

Editor:

Attached is a drawing of a coal board that we have successfully tried on some locomotives here, and are now gradually introducing into general service, which prevents the coal from falling off on each side. Our first boiler-maker, Mr. T. S. Bridges, a very accomplished workman



A DEVICE THAT SAVES COAL.

with an inventive turn of mind, brought the idea here with him and placed the first one in operation.

The device consists of a piece of sheet iron 24 inches in height bolted on the regular grooves for coal board with wooden boards on top of this to any desired height. There are two sheet iron wings fastened in the center, as shown in the drawing, to form a scoop entrance.

As is well known there is a very considerable amount of coal wasted in falling between the engine and the tank in the course of year, and as this device practically eliminates this waste, and also keeps the floor clear where the fireman must necessarily stand, and being easily and cheaply constructed it pays for itself in a very short time.

R. S. Booth.

Hickory, N. C.

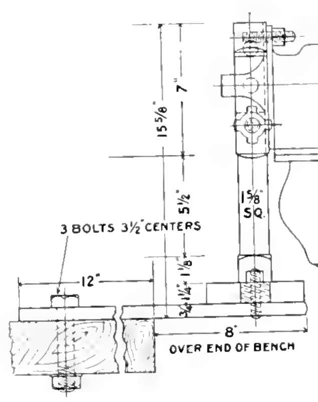


FIG. 1. SIDE ELEVATION WITH TRIPLE VALVE IN POSITION.

Triple Valve Cleaning Stand.

Editor:

Having received a number of requests from readers of Railway and Locomotive Engineering for further particulars in regard to the triple valve cleaning stand, a description of which you published on page 127 of your April issue, would request that you publish the attached diagram giving full dimensions and other information wanted by your readers.

Figure 1 is a side elevation of the device, with the triple valve shown in position. Figure 2 a front elevation without the valve.

The device referred to was designed by me for holding triple valves while cleaning with the advantage of keeping the slide valve seat in view during operation.

W. S. Everly,

F. A. B. Shops, B. & O. R. R.

Mt. Clare, Baltimore, Md.

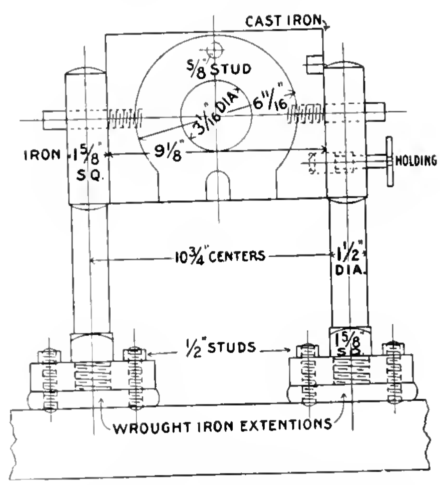


FIG. 2. FRONT ELEVATION WITHOUT VALVE.

Wanted—An Air Brake Story.

The Westinghouse Air Brake Co. is desirous of obtaining a record of air brake performance in the form of true stories that tend to illustrate the value of the Westinghouse air brake in terms of performance and capacity.

The stories may constitute spectacular escape from wreck or disaster or demonstrate the larger earning power through ability to safely control heavy tonnage, longer trains, higher speeds or increase in traffic.

Each instance must be written from practical experience, personal observation or from first hand information obtained from railroad men who actually know the facts.

The W. A. B. Co. offers $2,000 in prizes for the best 6 stories, $1,000 for first prize, and any railroad employees wishing to submit a story should apply to the company for the conditions governing the competition. Stories must be in the hands of the judges before Aug. 1, 1914.

Ignition Temperature.

Fuel will not burn until it has reached what is known as the igniting temperature. That temperature varies with different kinds of fuel. Coal gas does not burn below a red heat of iron, and carbon such as charcoal has a still higher igniting point. A piece of iron heated dim red will not ignite a gas jet, but if the iron is heated till it approaches orange color it will light the gas. The igniting temperature of coal burned in locomotive fireboxes is about 1,500 degs. Fahr. Firebox temperature is about 3,000 degs. Fahr.

Annual Convention of the American Railway Master Mechanics' Association

The forty-seventh annual convention of the American Railway Master Mechanics' Association was held at Atlantic City, N. J., beginning June 15 and continued during the following two days. The president, Mr. D. R. MacBain, presided and made an excellent opening address, pointing out the growing importance that was being attached to the meetings of the association. His suggestions were pointed and of much value coming as they did from a man of wide and varied experience. Mr. J. W. Taylor, the secretary, presented the various reports, which were models of clearness, and all showed that the association was continuing in its growth in spite of the continued business depression which from various causes affect the American railroads.

As formerly the Railway Supply Men's Association had provided an excellent exhibition of railway appliances, which extended through the entire length of the pier. The decorations set off the fine machinery to much advantage, and it is doubtful if anything of the same kind could be found in the annals of mechanical exhibits that could rival the elaborate setting in which the display is made. The uniform courtesy of those in charge of the complex exhibits and the interesting descriptions of the minute details of the mechanism was in itself of the highest educational value, not only to the younger members, but even to those who have become more or less familiar with the finest exhibitions.

The sessions of the convention were as usual from 9:30 a. m. until 1:30 p. m., and the close attention given to the various reports and the ready and fluent debates showed a growing keenness in the proceedings that is a reflex of the thoughtful study on the part of the members in the important department of railroad work in which they are engaged. There never was any necessity on the part of the presiding officer or chairmen of committees to push the business.

Our space available precludes the possibility of presenting the reports of the committees with that degree of fulness that we would wish, but the following condensed reports give a fair reflex of the variety of the subjects and the marked ability with which they were handled.

Locomotive Headlights.

The special committee on locomotive headlights of which Mr. D. F. Crawford, General Superintendent Motive Power, Pennsylvania Lines West of Pittsburgh, is chairman, presented a report, the longest perhaps ever presented before any mechanical association. It embraces 330 pages, profusely illustrated with reproductions of photographs and diagrams and presents a mass of evidence on this important subject. It will be remembered that the committee made a report at the 1913 Convention. The committee were continued with some additional members and instructed to report to the members prior to the Convention of 1914.

That the work has been done with a degree of thoroughness that could not be surpassed is evident from the fact that the various types of headlights now on the market were procured, from the minimum oil headlight to the maximum electric arc headlight. Twenty men devoted their entire time to the investigation under every imaginable condition during a period of five months. After going over these tests in detail and after thorough discussion, the committee recommends that in order that a headlight shall be of such intensity as not to cause misreading of signals, obscuring of hand signals, fusees, red lanterns and classification lamps by opposing headlights, and be of such intensity as not to temporarily blind the engineman looking into the same, a headlight must have an apparent beam candle-power, not greater than 3,000, referred to the center of the reference plane, from 500 to 1,000 feet ahead of the locomotive.

In order that the engineman shall have sufficient illumination ahead of the engine to allow him to readily perform his duties while operating in and out of passenger terminals and industrial sidings, while switching in yard, and to readily locate whistle posts, yard limit and crossing signs and such other landmarks en route, a headlight, due to depreciation or to variations in the intensity of the source, must not at any time during service have apparent beam candle-power less than the following; the readings to be made in a vertical plane 25 ft. ahead of the focal center and referred to points at the various stations in the reference plane.

READINGS AT CENTER OF REFERENCE PLANE.

Reading point ahead of focal center.	Apparent beam candle-power.
500 ft.	Not less than 450 c-p.
600 ft.	Not less than 490 c-p.
700 ft.	Not less than 500 c-p.
800 ft.	Not less than 500 c-p.
900 ft.	Not less than 500 c-p.
1,000 ft.	Not less than 500 c-p.

AVERAGE SIDE READINGS (AVERAGE OF READINGS TAKEN AT EACH STATION 20 FT. EACH SIDE OF THE CENTER).

Reading points ahead of focal center.	Apparent beam candle-power.
50 ft.	Not less than 30 c-p.
100 ft.	Not less than 110 c-p.
200 ft.	Not less than 225 c-p.
300 ft.	Not less than 315 c-p.
400 ft.	Not less than 350 c-p.

Revision of Train Brake and Signal Information.

The committee dealing with the revision of train rules and signal information, of which Mr. R. B. Kendig, of the New York Central Lines, was chairman, presented an important report containing thirty-nine specific instructions to enginemen, trainmen, engine house foremen and inspectors. As soon as possible the committee's revised instructions will be circulated among the railway men affected. It need hardly be stated that the "Safety First" movement has guided the committee in their careful consideration of the report, and while the instructions do not differ radically from the regulations previously in use they embrace fuller details of the work of railway employees in regard to brake and signal matters.

The committee closed their report by referring to the necessity of a new train signal—this with a view of accelerating the development of a signal device which shall be entirely satisfactory in its operation, such signal to permit of easy and prompt communication both between the train crew and enginemen, and the enginemen and train crew, under all conditions of service.

Locomotive Stokers.

The report of the Committee on Locomotive Stokers, of which Mr. A. Kearney, assistant superintendent of motive power, Norfolk & Western railway, was chairman, presented a complete review of the development of the stoker and the lines along which the inventors have been working. The committee refrained from expressing an opinion as to the comparative merits of the underfeed and the scatter or overfeed types, as both kinds have their strong points. Referring to the different types of stokers and the number in use, it appears that there are now of the class known as the Street Stoker 418 and 82 on order. This stoker is of the scatter type and handles crushed or slack coal, and is performing the work expected of it. Of the Crawford

stoker there are 301 in service on the Pennsylvania Lines West of Pittsburgh. The machine which is of the underfeed type handles run of mine coal, producing its best results using the higher volatile products.

Of the Hanna stoker which is of the scatter type there are 3 in operation and 21 in course of construction. The reports show that the machine does its work satisfactorily using run of mine coal. The Standard stoker has been introduced since last year and tests made on heavy freight service on the New York Central, and the reports are full of promise. In this type of machine the coal is reduced to the required size by an arrangement of the feeding screw. A number of stokers of this type are already ordered, and it bids fair to come into popular favor.

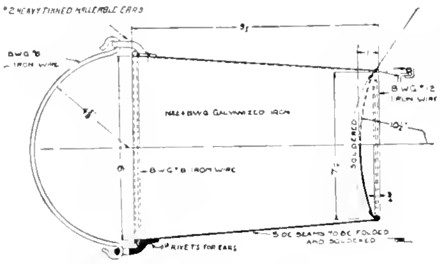
Of the dozen or more other types of stokers the majority are in the experimental stage, and it is a notable fact that a large number of the leading mechanical inventors of our time are busily engaged working out the stoker problem along varying lines and the outcome cannot be other than the eventual complete success of this important appliance to the modern locomotive.

Standardization of Tinware.

Mr. M. D. Franey, master mechanic on the Lake Shore & Michigan Southern, at Elkhart, Ind., chairman of the Committee on the Standardization of Tinware, presented an interesting report on the subject, accompanied by about twenty illustrations of various articles, and it appears that during the year 1911, a very complete paper on the standardization of tinware was presented to the Railway Storekeepers' Association. The committee which compiled the report collected the data from practically all of the leading railroads, giving the dimensions of the various tinware used in their respective departments, this including articles manufactured from galvanized iron. The Master Mechanics' Committee, in preparing their report, received some very valuable suggestions from the Storekeepers' Committee, although confining themselves to the consideration of tinware which would naturally be included in the locomotive department.

The committees were of opinion that they could not hope to present dimensions that will be adopted by each of the railroads. Many of the roads now have their standards, and for various reasons they do not wish to depart from the same. There are many railroads, however, that have not adopted a standard, and while the committee has studied principally the method of construction and the material to be used, they also selected the dimensions that in their judgment will be most suitable for the service for which each article will be used. This is probably as near as may ever be expected to come to a standard on tinware.

As an illustration, it is well known that a tank bucket has to withstand very severe usage. For this reason the committees recommended a tank bucket with a bottom of very small diameter, designed with a specially formed wire guard fastening the bottom in place. The bottom of the bucket is also depressed so that it can set over a projection without injury.

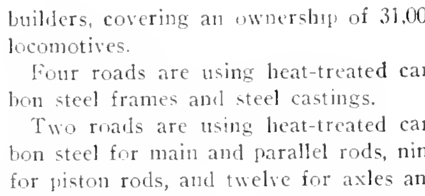


TWO-GALLON TANK BUCKET.

This form of construction will very successfully withstand the service, and the force of a blow to which the tank bucket may be subjected.

Special Alloys.

The report of the committee on the use of special alloys and heat-treated steel in locomotive construction of which Mr. A. R. Ayers, general mechanical engineer of the New York Central Lines, was chairman, was an excellent illustration of how thoroughly a well selected committee under accomplished chairmanship can do the work expected of it. A circular of enquiry was issued by the committee and replies were received from thirty-seven railroads and two locomotive



LOCOMOTIVE CRANK PIN AFTER TESTING.

builders, covering an ownership of 31,000 locomotives.

Four roads are using heat-treated carbon steel frames and steel castings.

Two roads are using heat-treated carbon steel for main and parallel rods, nine for piston rods, and twelve for axles and crank pins.

Two roads are using it for tires and wheels, compared with five, one year ago.

One road has discontinued its use altogether, on account of unsatisfactory service obtained.

The use of heat-treated carbon steel is still experimental, and does not appear to have been appreciably extended.

The committee were of opinion that the manufacture of plain carbon and alloy steel to be quenched and tempered will eventually be developed to the point where such material can be used in designs involving much higher unit working stresses than are possible with untreated or annealed plain carbon steel, with a consequent reduction in the weight of parts. In the case of rapidly moving parts, this reduction of weight may also be expected to result in reduction of wear. For these reasons the committee believes that there is a wide and important field for the use of quenched and tempered carbon steel and alloy steel in locomotive construction, and wishes to emphasize the importance of making continued and extensive service tests with these materials, to encourage and assist in their development.

The toughness of properly quenched and tempered carbon steel is demonstrated by the accompanying illustration of a hollow-bored crankpin. The hole was badly bent and partly closed without any evidence of cracking of the material.

Revision of Standard Efficiency Tests of Locomotives.

Mr. C. D. Young, chairman of the committee on the above subject, reported at considerable length, the report covering over forty pages and presenting in detail a code for the testing of locomotives, both upon the road and in the laboratory, which embraced not only the method of conducting the tests, but the manner in which the results should be tabulated and proper formula for computing all of the items required for the complete test. This included the laboratory tests, description, dimensions and proportions of all of the parts, with analysis of coal and dynamometer tests, with a complete summary of average results, road tests, with an appendix. As an example of the methods it may be interesting to note the method used to determine discharge from locomotive safety valves on road tests and which was first established by the Norfolk & Western Railway Company. The following extract from the report illustrates the method:

The outer side of one of the safety valves is drilled and tapped near the top of the muffler for the insertion of a plug (flush with the inside wall of the valve muffler), threaded at each end with a 3/8-inch pipe thread. The plug forms a conical convergent nozzle having a minimum orifice of 3/32 inch in diameter. A 1/4-inch wrought-iron pipe is run from the plug connection down to the rear of the locomotive cab roof, where a flexible connection, such as a rubber steam hose, is made of sufficient length to reach the bulkhead of the tender. From here a 1/4-inch pipe is run down along the side of the tender to a point where it is

directed into the water compartment and connected to a 1-inch coiled pipe, or condenser, extending down to the bottom of the tank and connecting with a small reservoir located on the outside of the tender frame. Steam, which is admitted to this line when the safety valves lift, is condensed in the coil and collected in the reservoir. A drain cock located at the bottom of the reservoir is used to draw off the condensed steam at the end of each test for the purpose of making the desired calibration.

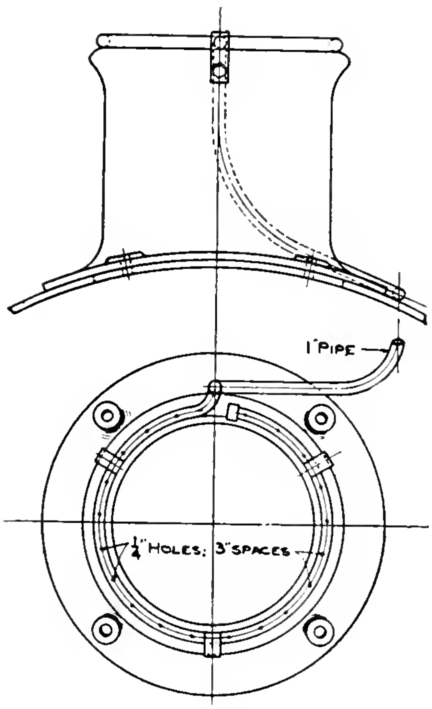
The accuracy of the determination required previously demands a very careful calibration of the safety valve and the orifice, so as to ascertain the exact ratio of steam discharge through the orifice to the total amount of steam discharged through the safety valves. This ratio determined, and the amount of condensed steam passing through the orifice ascertained at the end of the test, the discharge at the safety valves may be calculated for the test period.

Fuel Economy.

A number of questions were sent out to the mechanical department heads of the railroads by the Committee on Fuel Economy. Mr. Wm. Schlafge, general mechanical superintendent of the Erie, was chairman and much valuable data was presented by the committee. Scale prevention was strongly urged, the report showing that for every 1/16 inch of scale 15 per cent. more fuel was required. Twenty-five per cent. of a saving in fuel was claimed by the use of superheating the steam. Feed-water heaters were not recommended. The use of the brick arch was strongly urged. Much saving was also claimed from the use of the brick arch. Doubt was expressed in regard to fuel economy by the use of mechanical stokers, the chief merit of the device being its capacity for firing larger quantities of coal than can be handled by a fireman. Interesting data was also presented in regard to a device in use on the Erie railroad attached to the safety valve showing how long the valve has been open during any stated period. The record made by the instrument is very impressive and admits of no argument. It enables the enginemen to be accurately informed of the amount of waste caused by unnecessary popping, and it goes a long way to assist in making instructions along this line effective. A 3-inch safety valve on a boiler carrying 200 pounds pressure will waste 146.7 lbs. of steam and about 20 lbs. of coal every minute during which it is open. When it is considered that from 7,000 to 20,000 lbs. of coal are wasted each month on a single locomotive, it is evident that the matter of loss through safety valves is something worthy of close attention and offers an opportunity to effect a considerable saving.

Smoke Prevention.

It will be recalled that at the convention last year the Committee on Smoke Prevention submitted a report embodying a description and the results of certain tests carried on by the Pennsylvania railroad at the Altoona testing plant. As a result of these tests certain conclusions were drawn and recommendations made. The committee was continued and under the chairmanship of Mr. E. W. Pratt, assistant superintendent of motive power on the Chicago & North Western, a set of five questions were drawn up, to be submitted to the mechanical officials of the various railways confronted by the smoke problem with the intention of bringing out the results of the recommendations. Twenty-five railroads replied with a total of 32,000 locomotives. Favorable reports were received from a large number of roads in regard to quick-opening blower valves, and the appliance is being rapidly adopted. Fifteen roads have installed jets largely in the form of side installations with some degree of success. Various devices were favorably reported upon, among others the Heffron draft regulator which has obtained some success. The device consists of an adjustable baffle plate partially closing the furnace door when opened, and folding back when the door is shut. Considerable success is also claimed for a ring blower at the top of the stack. This device cost about eight dollars, and claims are made that by its use there is almost complete elimination of the smoke on the road and the prevention of smoke trailing into the cab. The accompanying illustration shows the device, consisting of a pipe one inch in diameter bent in a circular form and placed on the top of the stack. The pipe is pierced with 1/4 inch holes 3 inches apart. The pipe is suitably connected to a valve in the cab.



SMOKE LIFTING BLOWER.

Revision of Standards and Recommended Practice.

The care with which the committees of the association perform the duties assigned to them was finely illustrated by the Committee on the Revision of Standards and Recommended Practice. Mr. W. E. Dunham, superintendent motive power and machinery on the Chicago & North Western, was chairman. A circular of enquiry had been sent to the mechanical departments of railways and a variety of suggestions was laid before the committee, some of which were concurred in and others rejected. A large number of corrections of drawings and additional descriptive matter was added to a number of published plates.

At the request of the chairman, laboratory tests were made in more or less detail of steel castle nuts made in full proportions to agree with the present standards excepting in the height of the nut, which was made the same as the U. S. Standard rough nuts. Also the threading for the bolts was extended to the top of the castellation. These tests were made by the New York Central Lines, the Pennsylvania Railroad, the Atchison, Topeka & Santa Fe Railway, and the Chicago & North Western Railway.

Locomotive Road Tests of Schmidt Superheater and Brick Arch.

Mr. H. W. Coddington, engineer of tests on the Norfolk & Western Railway, presented a very interesting individual paper on a series of tests made on two locomotives of equal dimensions with a view to test the efficiency of the use of superheated steam as compared with saturated steam, and also a comparison with or without the brick arch in connection with the use of the superheater.

From the report it appears that by a review of the advantages incident to the use of the superheater the locomotive hauled 13.3 per cent. more cars and 16.1 per cent. more tonnage at an increase of 30 per cent. higher speed, an increased boiler pressure of 3.3 per cent., with a decreased coal consumption of 26.8 per cent. An increase on the indicated horsepower amounting to 36.1 per cent. was observed in the performance of the superheated locomotive.

In regard to the use of the brick arch it was observed that there was an indication of a 5 per cent. saving in coal in the performance of the superheated locomotive with a brick arch as compared with the same superheated locomotive without the brick arch. Apart from the

coal consumption there are other features favorable to the arch installation, such as the protection of the flues from sudden changes of temperature, and also from stopping up. The paper very strongly pointed out the marked advantages which may be attributed to the use of superheated steam.

Electric Motors in Railway Shops.

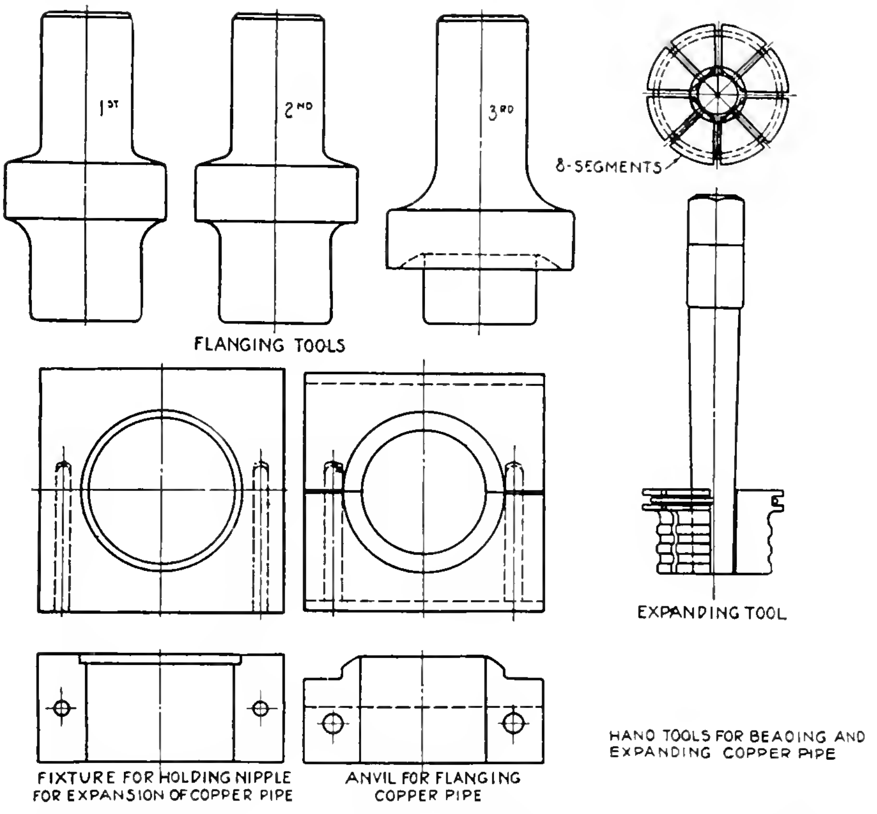
Of the individual papers presented it might be said that they were all timely and interesting, the use of electric motors in railway shops was handled by Mr. B. F. Kuhn, master mechanic on the Lake Shore. After discussing the various types of motors and the two great divisions in the application of electricity by the alternating current and the direct current systems, and pointing out the fact that before adopting either the actual cycle of operation of each individual machine should be carefully considered. Mr. Kuhn closed by alluding to the fact that with shop equipped with tools for motor drive the whole shop layout can be rearranged from time to time to suit the various conditions which may arise in the method of handling the different work and also the installing of additional new tools, and it is also possible to take advantage of floor space, which in the case of a shop with line shafting it would be impossible to utilize.

A very distinct advantage that the shop equipped with motor-operated tools has over the shop operated with line shafts is that the belts and overhead work are done away with. Such shops are lighted much more efficiently and a great deal of danger is eliminated. In this day of "Safety First" the elimination of line shaft and belt drive is something that we all should strive for, and in the revamping and extending of our shops the question of abandoning line shafts and belts should receive very serious consideration.

Couplings for Injectors.

Mr. O. M. Foster, master mechanic on the Lake Shore at Collinwood, Ohio, presented a paper relating to the dimensions for flange and screw couplings for injectors. In developing the subject matter for the paper, Mr. Foster had sent out inquiries to a large number of railroads requesting data covering designs and proportions of brazing rings, coupling nuts, pipe unions, etc., in use, the replies indicating that in most cases manufacturers' standards for these parts were being followed. Upon request, each of the injector manufacturers furnished a very complete set of detail drawings covering the parts entering into the makeup of the pipe connections used with his various types and sizes of injectors.

From these it was gathered the threaded diameter of many of the parts varied in such a manner as to present a serious objection in the matter of proper interchangeability. A variety of tests also showed that, while there are a number of methods in brazing, all showed an ample factor of safety in a carefully brazed joint. With the idea of overcoming the element of uncertainty appertaining to the strength of a brazed connection, there has been developed during the past year a so-called "Mechanical Joint" for copper pipe. This connection consists merely of a beading ring or sleeve through which the copper pipe is extended and beaded over on the ball collar to form the ball joint seat.



HAND TOOLS FOR BEADING AND EXPANDING COPPER PIPE

When there is not sufficient work of this kind to justify the installation of a mechanical pipe-beading machine as may be desired, the work can be done with a set of hand tools similar to those shown in the accompanying illustration. The sequence of operations is as indicated in tools 1, 2 and 3, after which the expanding tool is used, provided the application is being made to groove rings. There is, however, some reason to question the real necessity for grooving the rings, and one of the large locomotive companies is making the application by merely rolling the pipe with a plain beading ring and beading the copper pipe over to form the ball joint seat.

The chief merit of Mr. Foster's paper lay in the fact that, while refraining from making any recommendations covering dimensions for injector connections, it was made apparent that there is need of definite recommendations covering design and sizes for brazing and beading rings, iron-pipe unions, coupling nuts and flanges, and no doubt improvements in these devices will come at an early date.

Safety Appliances.

An oral report on safety appliances was presented by D. R. MacBain, chairman of the committee. According to his information the work is practically completed, and progress in equipping the locomotives has been very satisfactory.

Review of Work of Other Organizations.

An individual paper was presented by Dr. Angus Sinclair on the Review of Work Done by Other Mechanical Organizations. Among the associations referred to and whose work was commended were: The Traveling Engineers' Association, the Air Brake Association, the International Railway General Foremen's Association, and the Railway Fuel Association. The report was accepted with the thanks of the convention.

Other Reports.

Reports were also presented on Superheater Locomotives and on Train Resistances and Tonnage Rating. The reports covering these subjects are so extensive that lack of space will not permit a reference to them in this issue.

We expect to take up these subjects and also the discussions attending the other reports that were submitted in future issues of RAILWAY AND LOCOMOTIVE ENGINEERING.

Annual Convention of the Master Car Builders' Association

The forty-eighth annual convention of the Master Car Builders' Association was called to order by Mr. M. K. Barnum, chief mechanical engineer of the Baltimore & Ohio, on Thursday, June 11, in the Greek Temple, on the million dollar pier at Atlantic City. The attendance was unusually large and the proceedings of the most interesting kind. The number and variety of subjects to be discussed seems to grow with the growing years, and the method of continuing some of the more important committees is an excellent one, and it has unquestionably brought out a mass of information that otherwise might have remained in the possession of single individuals, but is now rapidly becoming common property. A notable feature of the work of the association has been the gradual but now almost complete standardization of material and the abandonment of haphazard means and measures that characterized much of the earlier car builders' work. Mr. Barnum made an excellent presiding officer, and while he has the happy faculty of bringing out that which is brightest and best in the members, he is also the finished parliamentarian and knows the method of bringing debates that are promising to run dry to a speedy vote. Mr. Jos. W. Taylor presented the reports, and his excellent delivery gives dry details a relish. The entire board of officers showed themselves to be the right men on the right places, and as long as the members of the association continue to show good sense in their choice of officers just so long will the association maintain its high place among the mechanical associations in America:

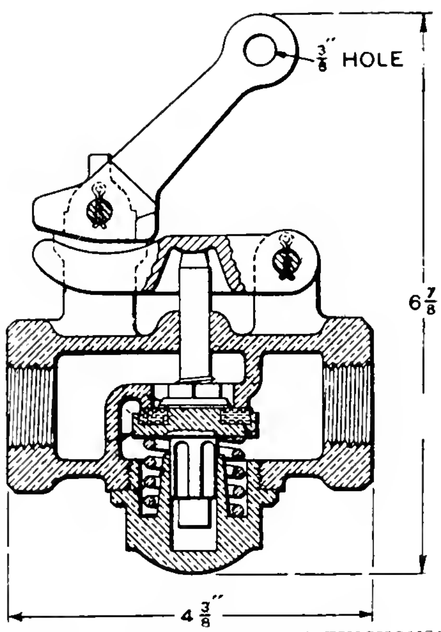
Subjoined are condensed reviews of the leading reports presented to the association:

Arbitration Committee.

The secretary submitted the report of the Arbitration Committee involving a large number of cases arbitrated during the year, and made recommendations of certain reviews of the rules of interchange, nearly all of which were adopted. All of the questions raised were not such as have been actual cases for arbitration, but have risen in different parts of the country in the ordinary interchange of traffic, and the general opinion was that this method of procedure has been beneficial to all concerned and has resulted in lessening the work of the inspector, the bill clerk and others. Considerable stress was laid on the importance of having the air brake equipment in all cases up to the standard requirements.

Train Brake and Signal Equipment.

Mr. R. B. Kendig, chairman of the above committee, presented a report embracing details of the construction and proper attachment of brake and signal pipe clamps for ends of passenger cars, and urged the selection of a particular type of conductor's valve, known as the B-3-A and shown in the accompanying illustration, and that such valve be corded the entire length. Where this cannot be done, as is generally the case in dining, buffet and certain classes of load carrying cars, the committee recommended that



CONDUCTOR'S VALVE. WESTINGHOUSE AIR BRAKE COMPANY.

two conductor's valves be installed, one at each end of the car, and that each be corded with the car a distance if necessary, including platforms, to permit of easy access. The cord should also be colored red, while the signal valve cord should be of gray color; also that the cords be made of metallic material, either wire or chain, the committee preferring chain for the conductor's valve, and hemp or cotton covered wire for the signal valve.

A code of air brake and signal instructions were added and approved.

Brake Shoe and Brake Beam Equipment.

The report of the committee on the above subject was presented by Prof. C. H. Benjamin, of the Purdue University, Lafayette, Ind., and the committee had considered two sets of problems, those relating to the behavior of brake shoes and those affecting the design of brake beams. From the numerous reports of tests submitted by the committee it appears that the coefficient of friction of most of the shoes decreased as the pressure increased, the two exceptions to this being the plain cast iron and the national. The plain cast iron shoe gave almost the same coefficient at all pressures, while the national gave almost the same coefficient at the three lower pressures and then made a sudden drop at 18,000 pounds pressure.

The committee recommended the desirability of having a complete review and digest of tests so far made, with suitable conclusions, to be made a part of the next year's proceedings, as there had not been time to prepare such a digest this year.

Revision of Standards and Recommended Practice.

Mr. T. H. Goodnow reported on behalf of the above committee, and called attention to a number of minor details in connection with journal boxes, wheel-flange thickness gages, wheel-defect and worn coupler-limit gauge, and limit gauge for remounting cast iron wheels. Safety appliances were discussed at considerable length and several valuable recommendations were adopted in regard to box-car side-door fixtures. In regard to journal box and details, it was recommended that a 3/16 in. radius should be shown at the extreme top edge of the hinge-pin lug. The distance from the center of the hinge-pin hole to the top arch-bar seat should be shown as 1 in. Distance between centers of 3/8-in. radii, forming fillets between hinge-pin lug and top of box, should be shown as 1/4 in. The distance from the inside top surface of box to the bottom edge of front stop lugs should be shown as 1/2 in. The straight distance on side of box from center line of bolt hole to where the sloping portion of box starts at the front end should be shown as 6 in. in the plan view. One-eighth in. fillets should be shown at bottom and sides of dust-guard opening instead of the sharp corners, and this should also be specified on the side edges of the center stop lugs. Center line for the hinge-pin hole to be added to the plan view, as well as a dotted line for the undercut in front of the hinge-pin lug. A dotted line should

be added to the elevation running through the hinge-pin lug and representing the top surface of the box at the sides of the hinge-pin lug. The undercut on the hinge-pin lug at the top of the lid fit should be shown as 1/4 in. The full vertical line representing the juncture of the front surface for the lid spring bearing and the hinge-pin lug proper should be changed to show dotted below the horizontal full line representing the top edge of undercut.

Coupler and Draft Equipment.

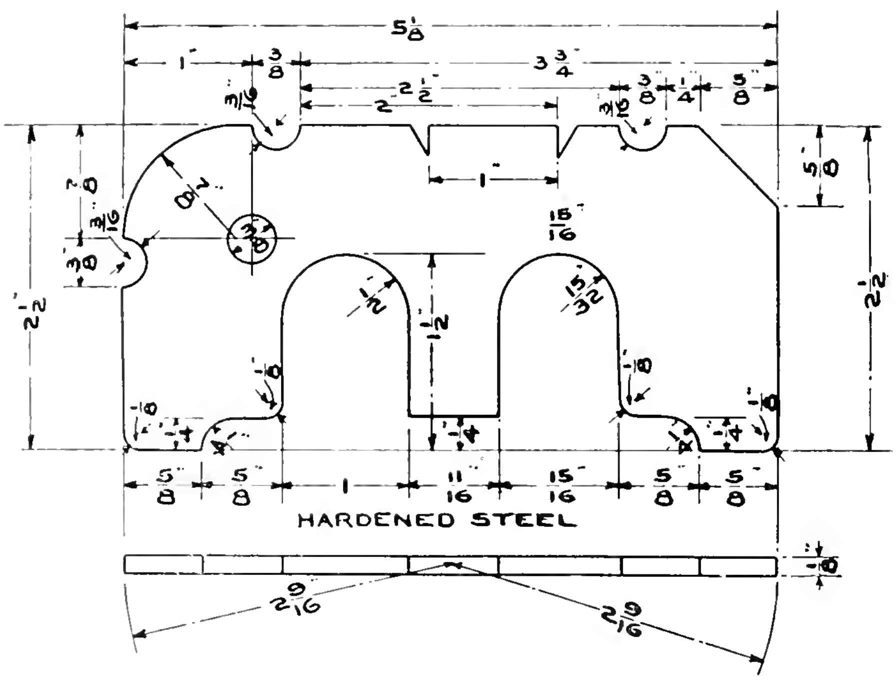
Mr. R. L. Kleine, chairman of the above committee, which had been continued from last year, reported that the comparisons and summaries in all of the tests showed conclusively that the experimental couplers were much stronger throughout than present types of couplers, and that the committee were working along the right lines. The work had been conducted jointly with the coupler manufacturers who submitted to the various meetings one or more designs of couplers embodying the specifications as laid down by the joint committee, the manufacturers having designed the working parts according to their ideas to meet the specifications. These designs were exhibited last year and several were selected to be tried in service during the present year to best determine the best contour lines, efficiency of operation and strength of the various parts, with a view of correcting any details that may prove unsatisfactory, to the end of establishing the standard coupler.

Car Trucks.

The Committee on Car Trucks, of which Mr. J. T. Wallis was chairman, reported a number of details in regard to the better construction of car trucks, but considered it impractical to recommend definite designs on account of cast steel trucks being generally covered by letters patent. The committee, however, tabulated drawings of the different truck sides manufactured, which were submitted to them with a view at arriving at the limiting dimensions for truck sides. These tabulations show a lack of uniformity in construction, not only for different roads, but of trucks of the same expected capacity on the same road. In regard to safety hangers for brake beam and the frequency of brake beams falling on the track, the report stated that the committee has given this subject careful thought and their experience with the majority of brake beam safety hangers has been that these devices have been inefficient and a source of expense from a maintenance standpoint. Unless they are designed with a strength at least equal to the loads imposed upon the brake beam hangers and to prevent wear, they will not be efficient when the emergency arises for them to perform their function. Furthermore, with the present lack of interchangeability and the uniformity of design of brake beams and trucks, it would be impracticable to design a standard safety hanger which would be generally applicable. Your committee finds little cause for the employment of brake beam safety hangers where the brake beam hangers and connections are designed and manufactured with proper care and believe that the remedy lies along these lines rather than in the adoption of the auxiliary device of brake beam safety hangers.

Car Wheels.

The report of the standing committee on car wheels, of which Mr. A. Kearney is chairman, set forth that a number of recommendations had been received from wheel manufacturers in the direction of heavier flanges. To increase the width of flange, however, would in all probability involve changes in the track in the way of providing more clearance through frogs, guard rails and railroad crossings. For the information of the members it was stated that the Bureau of Standards of the Department of Commerce is preparing to make an experimental study of chilled car wheels, which will include foundry practice, investigation into the chemistry, metallurgy and mechanics of wheels, etc., and it is the intention of the Bureau of Standards to ask the co-operation of the wheel manufacturers and the wheel users in making the investigation.



WHEEL DEFECT GAUGE.

In order to provide means for measuring flat spots of 1 in. and 2 ins. in length on passenger and freight car wheels respectively, it is recommended that two additional notches be provided in the present standard defect gauge, as shown in the accompanying drawing.

Car Construction.

Mr. W. F. Keisel, chairman of the Committee on Car Construction, presented a report wherein it appears that the report of 1913, covering minimum strength of center sills of existing steel and steel underframe cars, was submitted to letter ballot, but should have been referred to the Arbitration Committee. A number of interesting details in regard to car construction was presented, from which we may quote a section: "The length of center or draft sill between adjacent tie plates or braces, or the length of any part of any center sill or draft sill between adjacent supports or braces, must not be more than 20 times the measurement across the section of member under consideration. The measurement across the section referred to must be taken whichever way the member is weaker, which, of course, will be the direction in which the member will buckle if overstrained. As an example: Center sills consisting of channels tied only at the top by floor plates, and having flanges 2½ ins. wide, may have the bottom flanges braced only at intervals of 8 ft. According to the rule given above, these bottom flanges should have braces at intervals of not more than 20 times 2½ ins., or 50 ins. Such car will, therefore, require an additional brace for anchorage about half way between the existing anchorages, and further that the minimum center-sill areas, between points of impact, on existing cars, may vary up to 55 sq. ins. Service experience demonstrates that the cars

having minimum center-sill strength are crippled in acting as cushions for the stronger cars. This makes it desirable to aim at uniformity of center-sill strength for all cars in the train. Designs of cars which do not go into general service in interchange may be considered only from their own load-carrying standpoint, without regard to train strains; but those used in interchange must be considered from both standpoints. For the latter, your committee recommends the following as minimum design requirements to produce cars giving maximum returns for money expended:

"Area of center sills: 24 sq. ins., minimum.

"Ratio of stress to end load: 0.06, maximum.

"Length of center or draft sill members between braces: 20 d, maximum ('d' is the depth of the member, measured in the direction in which buckling might take place)."

Specifications and Tests for Material.

The committee on the above subjects was instructed to revise certain specifications of the association and prepare new ones covering certain other classes of material covered in the recommendations of last year's committee on form. Accordingly specifications covering sixteen different classes of material were sent out for criticism by the members, and, as a result of these criticisms and subsequent meetings, it was agreed that the following-named materials only could be handled this year: Air brake hose, heat-treated knuckle pivot pins, steel axles, refined wrought iron bars, welded pipe, helical springs, chain and journal box brasses and that the specifications covering the following materials could be further investigated and specifications offered at the next annual meeting: Refrigerator car heat insulation materials, mild-steel bars for miscellaneous parts, steel castings, rivet steel and rivets, structural steel and steel plates galvanized sheets, malleable iron castings and elliptic springs.

F. F. GAINES,
President, M. M. Association.

Safety Appliances.

On behalf of the Committee on Safety Appliances an oral report on the subject was submitted by Mr. M. K. Barnum, chairman. He explained that there appeared to be a serious lack of understanding as to the exact requirements of the law. Penalties for non-conformity become operative in July, 1916. Mr. Barnum made a strong appeal for a campaign of instruction so that car-men may come to understand just how and where these appliances should be placed on the cars.

J. WILL JOHNSON,
President, R. S. M. Association.

Train Lighting and Equipment.

The Committee on Train Lighting and Equipment, Mr. T. R. Cook, chairman, submitted a report dealing principally with the matter of pulley fits on the axles of dynamo carrying trucks.

Reports were also submitted covering the Prices for Labor and Material in the Interchange of Car Repairs, Specifications and Tests of Tank Cars, the Advisability of Retirement from Interchange Service cars of 40,000 and 50,000 pounds capacity, Damage to Freight Car Equipment by Unloading Machines, Rules for Loading Materials, and the Interline Loading of Commodities.

At the recent meeting of the Railway Master Car Builders' Association Mr. D. F. Crawford, Gen. S. M. P. of the Pennsylvania Lines West, was elected president of the association; Mr. D. R. McBain, S. M. P. of the Lake Shore & Michigan Southern, first vice-president; Mr. R. W. Burnett, Gen. M. C. B. of the Canadian Pacific, second vice-president; Mr. C. E. Chambers, S. M. P. of the Central of New Jersey, third vice-president, and Mr. John Lentz, M. C. B. of the Lehigh Valley, treasurer. Messrs. R. E. Smith, Atlantic Coast Line; J. C. Fritts, of the Lackawanna, and H. T. Bentley, of the Chicago & North Western, were elected members of the Executive Committee.

In the election of officers of the American Railway Master Mechanics' Association for the ensuing year Mr. F. F. Gaines, S. M. P., Central of Georgia, was elected president of the association; Mr. E. W. Pratt, A. S. M. P., Chicago & North Western, first vice-president; Mr. Wm. Schlafge, Gen. M. S. of the Erie, second vice-president; Mr. F. H. Clark, G. S. M. P. of the Baltimore & Ohio, third vice-president; Treasurer, Dr. Angus Sinclair. Messrs. C. F. Giles, S. M., Louisville & Nashville, and M. K. Barnum, Gen. M. I., Baltimore & Ohio, were elected members of the Executive Committee.

At the annual meeting of the Railway Supply Manufacturers' Association officers for the year 1914-1915 were unanimously elected as follows: Mr. J. Will Johnson, Pyle-National Electric Headlight Company, president; Mr. Oscar F. Ostby, Commercial Acetylene Railway Light & Signal Company, vice-president. Members of the Executive Committee: Mr. C. E. Postlethwaite, Pressed Steel Car Company, and Mr. P. J. Mitchell, Phillip S. Justice & Co., third district; Mr. George H. Porter, Western Electric Company, fifth district; Mr. Frank E. Beal, Magnus Metal Company, sixth district.

D. F. CRAWFORD,
President, M. C. B. Association.

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Master Car Builders' and Master Mechanics' Conventions.

The writer has attended the annual conventions of the Master Car Builders' and of the American Railway Master Mechanics' Associations for 31 years. It might naturally be supposed that listening to reports and hearing discussions of the same for those long years of subjects relating to cars, locomotives and other railway machinery would lead to weariness of the flesh, but strangely enough the subjects coming up for investigation year after year excite no sense of fatigue or ennui. He was brought up to listen to two long, weary sermons every Sunday, which was good training for listening to engineering discussions.

Both the Master Car Builders' and Railway Master Mechanics' associations held conventions at Atlantic City last month which were as well attended as any of those previously held, and the work done was equally important to the business performed at any of the numerous meetings held since the associations were organized. Then as now hundreds of technical organizations of a voluntary character, whose purpose is the disseminating of information concerning their business in which the members may be engaged, or to make the business done by the members more profitable to their employers. This may be accepted as applying in the railway world to all technical societies and clubs, ranging from the American Society of Civil Engineers, the American Railway Association, all the mechanical associations and all the railroad clubs. It may appear to be a mystery how all these technical organizations continue to find new and important subjects for discussion, yet there appears to be no inclination toward sameness in their proceedings.

The story is told of a civil engineer who had a literary turn of mind, and had an aptitude for writing concerning his business, and passed many pleasant hours writing articles for various technical journals, being offered the position of managing editor of a technical weekly. He accepted readily, and the first two or three numbers were objects of joy to the new editor. He kept congratulating himself on his good fortune in securing, at a high salary, work that he had been accustomed to perform as amusement. When four or five numbers had been made up, largely from notes on experience of the editor, he began to realize that his fund of material was running shorter. In a couple of months he was suffering acutely from the condition that his friends described as being pumped dry, a condition that many others had gone through. Resigning the position was decided upon by this short-time chief editor to escape a threatened attack of nervous prostration.

Selecting subjects for investigation and discussion for technical societies is a hard task, but it is always well done. We are not acquainted with any engineering literature of greater value to railroad men than the proceedings of the Master Car Builders' and the Master Mechanics' Associations, yet the investigations and discussions are always full of new facts, clothed in new thoughts that display no tendency toward threadbare conditions.

During the forty-eight years of its history the Master Car Builders' Association has been engaged upon work that had intimate connection with the management of freight traffic, since the capacity of cars settled upon by the Master Car Builders' Association influenced strongly the changes made by the freight carriers. With that line of progress always calling upon the car builder to increase the carrying capacity of cars, there was no want of subjects to occupy the attention of the annual convention committees, and no one can truthfully say that the work done was unsatisfactory. When the whole work of making details harmonize with the change in capacity of cars is considered, the wonder grows at the efficiency displayed with so little sign of pretention. To enumerate details of improvements worked out by the Master Car Buliders' Association would be to publish a mass of reading matter beyond the limits of our space.

At the last convention the Master Car Builders' Association put through eighteen reports, some of them of a highly important character. There were reports of nine standing committees and of nine special committees, eighteen in all. It required very skillful management on the part of the presiding officer and of the chairmen of committees to accomplish this mass of business without delay or confusion. Most of the committees dealt with semi-expert work that is of the highest importance to railroad companies.

The convention proceedings represent the routine work of the Master Car Builders' Association, but besides that other highly important work is done. The labors of the association in connection with the interchange of cars is very great, and the work done by the arbitration committee alone is worth more than all the time and expense incurred in keeping the Master Car Builders' Association in existence.

When the American Railway Master Mechanics' Association was organized in 1868, the most common form of locomotive in use was the eight-wheel American type, with cylinders about 16 x 24 inches, four low-speed driving wheels 60 inches diameter, and a boiler providing about 800 square feet of heating surface, the grate area being usually about 16 square feet. The engine in working order weighed about 50,000 pounds.

The railway world had passed beyond the wood-burning period and the locomotives burned bituminous coal without any attempt at smoke prevention, and the public had not begun to howl about smoke from locomotive smoke stacks darkening the atmosphere. Many railway officials had come to consider the locomotive perfect for all practical purposes. Iron was king of the 1868 locomotive, boiler, firebox, tires, frames, driving wheels and all rods being of that material.

The American Railway Master Mechanics' Association labored under a curious disadvantage for a few years, many of the higher officials having regarded it as an aristocratic form of labor union. The underpaid condition of railroad mechanical officials naturally suggested the labor union suspicion. At several of the early conventions, prominent members considered it necessary to deny that the association had any labor union tendencies. The published proceedings

contained the best proof that the purpose of the organization was the collecting of information concerning railway motive power that would lead to the improvement of the engine and increase its durability.

The Forty-seventh Annual Convention, which met at Atlantic City last month, handled thirteen reports and four individual papers, making up with the discussions one of the most profitable conventions ever held. Two of the reports represented immense special experimental work and were the most thorough and expensive reports ever submitted to the association. One was on locomotive headlights, D. F. Crawford, of the Pennsylvania lines, being chairman. He, with a strong committee, has labored on this subject for two years, and they left very few facts unsettled about headlights. Besides giving the members exhaustive information concerning headlights, it is expected that this report will be valuable in giving information to legislators and others desiring facts about headlights.

The other voluminous report was that on superheaters. This was prepared by the chairman, J. T. Wallis, of the Pennsylvania Railroad, who also was assisted by a strong committee. Many of the members are still in an instruction class in respect to superheaters, but they can make themselves masters of the subject by studying Mr. Wallis' report. One of the individual papers by H. H. Coddington, of the Norfolk & Western, described road tests of the Schmidt superheater, so the annual volume, when it comes out, will form a hand book on superheating. We expect to notice elsewhere the other reports submitted to the convention.

Scientific Railway Mail Pay.

The Government's postal receipts increased one-third within the five years before the parcel post service was added to the strict mail service. This increase would have been impossible without the help of the railways, and yet the railways receive nothing more for their services, says the New York *Times*. The Government income from the Post Office increased $63,000,000, and none of the increase was allowed to the railways. The case between the Government and the railways is essentially the same as the case between the railways and the shippers. The railways' gross has increased and their net has fallen. The railways are working harder and getting less money from those who employ them. It has been a long and hard fight to convince the public that this is so, but as regards shippers in general the case has been won. The opinion that the railway rates ought to advance is general. Yet this opinion has not animated the sentiment of Congress on the railway mail pay question. It is now proposed, not that the railway mail pay shall be increased at all, but that it shall be reduced.

Heretofore railway mail pay has been calculated at long intervals, and the railways carried the growth between calculations for nothing. They also furnished space in cars for which they were not paid, and what was called "side" services were exacted at terminals for nothing. The Government has gone so far as to admit that this was wrong and ought to be changed in the interest of the railways and the Government's sense of fairness. So the Government's lawmakers have wrestled with the subject and have determined that the railways should be paid by the distance they carry the mails and for space which they supply, side services being abolished. There are to be a line charge and a terminal charge, and everything is scientific to the last degree.

The railways have issued a statement on the subject in which they ignore the scientific advantages of the plan. They think they have made out a case of underpayment, in fact, and they are in no mood to accept a theoretical payment of less. They calculate that the scientific method will pay them less by $10,000,000. Senator Bourne's estimate is a reduction of $2,500,000. The railways hardly can be blamed for their indifference to the technique of the calculation. Even Mr. Brandeis has said that the Postal Service was unremunerative to the railways, and now the representatives of the people are preparing to reduce it scientifically. In all candor, it may be asked whether the anti-railway sentiment of Congress is the sentiment of the people who so generally favor the advance of railway rates.

Locomotive Headlights.

The report of the Committee of the American Railway Master Mechanics' Association on Locomotive Headlights is the most exhaustive evidence of special investigation ever submitted to the association and contains a vast deal of original information concerning illuminants. The original purpose of a locomotive headlight was to indicate to people along the line the approach of a train; but under the dangerous American practice of using railroad tracks as paths for the convenience of pedestrians, the demand has gradually arisen for a headlight to throw light ahead sufficiently powerful to indicate the presence of a trespasser on the track in time to stop the train, or at least to reduce the train speed very materially. In all countries outside the American continent the locomotive headlight is merely required to fulfill its original purpose of indicating the approach of a train.

With the introduction of high-power headlights upon our railways, many locomotive engineers regarded the powerful illuminant as a new source of comfort, so that sentiment in favor of high power headlights was easily cultivated and laws were rushed through the legislatures of several States, making the use of high candle power headlights compulsory. This action was very embarrassing to many railroad companies, and the demand for investigating the subject of locomotive headlights was pressed upon the Railway Master Mechanics' Association and resulted in the report under notice. A strong committee was appointed to investigate the subject of which Mr. D. F. Crawford, of the Pennsylvania Railroad, was chairman. He took up the investigation with much thoroughness, both the advantages and the drawbacks of powerful headlights being demonstrated, the weight of evidence being against very powerful headlights.

In the discussion on the report on locomotive headlights, a statement was made that locomotive engineers have been influenced to favor high power headlights, owing to the gross carelessness that many railroad companies display in the case of oil headlights and their attachments. The truth of this charge can be easily substantiated by any one interested on paying a visit at night to some large switching yard or to take notes of passing trains in the neighborhood of a track where many trains pass.

There is said to be a movement in action to use the report on locomotive headlights as a forcible argument with State legislators to change the laws already on the statute books demanding the use of high power headlights. To give influential aid to such a movement, we would suggest that pressure be put upon railroad companies to devote sufficient attention to their low power headlights to make them fulfill the purpose of their use.

Railway Valuation.

The important task of making a valuation of every railway in the United States was begun in half a dozen different parts of the country last February. According to the *Scientific American* it will take at least six years and will cost approximately $12,000,000.

The Interstate Commerce Commission is carrying on the enterprise in accordance with an act of Congress signed in March, 1913. Mr. Charles A. Prouty, for a long time a member of the commission, has charge of the work.

The first part of the gigantic task is to verify the maps and inventories that each railway is required to furnish. In making the verification, surveyors will inspect every mile of the road. It is that part of the work to which, strictly speaking, the

term "physical valuation" applies. It is mainly an engineering task, expensive and slow, but comparatively simple. From the information thus acquired it should be possible to tell how much it would cost to reproduce the property, and in what state of efficiency the road is being kept up.

But before the value of any one of these properties for use as a railway can be determined, the commission must decide some very difficult questions. For example, if a railway company made a mistake in determining its line, is the cost of rectifying the mistake to be counted an unavoidable "development expense," or as a loss that the owners of the property should stand? Again, the Northern Pacific acquired for nothing its right of way through the city of Spokane—a right of way that is now declared is worth $5,000,000. Shall this "unearned increment" be counted as a part of the value of the road, or not?

There exists in some quarters a feeling that the railways are charging the public too much for the service they render. Where expenses are wastefully large, or where there is over-capitalization, rates are of course unfairly high. Because cases of both kinds are known, many people fear that others exist that are unknown. On the other hand, it is a fact that certain roads have improved their property out of earnings, without any corresponding increase in their capital accounts, so that their actual value is greater than their total issues of stock and bonds. The case of such railways, when they ask permission to increase their rates, is obviously quite different from that of other roads.

It is the uncertainty arising from this state of things that has led to the establishment of the Division of Valuation of the Interstate Commerce Commission. As often happens in cases in which there is much mutual distrust and recrimination, the best course is to fix a standard of judgment and to ascertain the actual facts, for that not only leads to intelligent action, but also creates an atmosphere in which both parties to the dispute are willing to work together for the common good.

Railroad Opportunity.

Opportunity to get from the bottom to the top, from the lowest to the highest, is wider and brighter in railroading than in any other industry. That seems like a large statement, but the facts bear it out.

An eminent statistician, finding that in 1910 there were 5,476 general executive officers directing the activities of about 1,750,000 employees, estimates that each employee should have one chance in 300 of becoming an officer if employees live as long as officers and officers are drawn from the ranks.

As a matter of fact, there is little chance about it; in railroading nothing is left to chance and little is gained by "pull." The essence of the business is service and he fares best who serves best.

For evidence of the richness of railroad opportunity look to the life-and-work records of the officers. It is the exception among them who got up to where he is otherwise than by ability, fidelity and energy. Most of them began on the bottom rung; precious few of them skipped any rungs on the road up.

Industry of Kansas Legislation.

The legislators of Kansas have been noted for passing laws that are oppressive to railway interests and thereby embarrassing to railway employees. But the industry and ingenuity of Kansas legislators has not been confined to opposing railway interests. They act as if every prosperous industry must necessarily be an enemy of the people. An act that has aroused some excitement is known as the Pure Shoe Law. The constitutionality of the so-called Kansas "pure shoe" law, passed in 1913, has been attacked in the Shawnee County District Court. The Payne Shoe Company of Topeka, on its own behalf and in behalf of 450 retail shoe dealers of Kansas, applied for and obtained an injunction in the District Court here against John S. Dawson, Attorney-General, and every county attorney in Kansas from enforcing the law, declaring it is confiscatory.

The law was passed by the 1913 legislature and provided that a shoe sold in Kansas containing any of the so-called substitutes — leather board, strawboard, leatheroid, fibre board, corn fibre or paste—shall be stamped to that effect. The shoes in stock are to be marked with the date of purchase.

The Crystallization of Metal.

The crystallization of metal particles, frequently called the fatigue of metals, is being constantly brought to our attention by the recurrence of accidents that might with a little forethought be avoided. The natural tendency of the highest grade of iron, whether rolled or hammered, is gradually to assume its original form of granulated particles. During the process of being manufactured into commodities the metallic molecules assume a fibrous or stringy form, but no sooner is the metal left alone than it immediately begins to assume the crystalline form. It seems as if disintegration began at once, though the process is slow. This process is however accelerated if the metal is subjected to severe stresses, and hence axles, cranks and pins gradually lose their elasticity and become brittle.

In locomotives and other machines subject to constant straining shocks the period of safety is practically known, and rules have been established with a fair degree of accuracy, prescribing the distance in miles beyond which axles and other parts should not be allowed to exceed without examination. It is to be regretted that this system of regulation is not more generally applied. Usually some serious accident happens before the fatigue of metals is thought of. Very often surprise is then expressed that a fracture occurs when some light work is being done, although work of a heavier kind has previously been accomplished with the same appliance without any appearance of weakening.

We recall an illustration from a case that occurred on a Southern railway, where a draw-bar pin broke causing the parting of heavy cars, with disastrous results. Two weeks later another accident exactly similar occurred. The lesson thus doubly impressed was learned at last, with the result that a number of pins were tested and broken by a single blow from a sledge. The broken ends of the pins looked like the fracture of burned steel. The annealing process was then promptly applied to the rest of the fatigued pins. Piles of them were covered by a wood fire, and they were allowed to cool in the ashes. The limit of six months' service is now fixed on the road in question for the service of draw-bar pins.

Another instance was that of a spring hanger breaking in a newly repaired engine, which had the effect of establishing the practice of annealing the spring hangers and other parts on all engines on that road while repairs were being made in the back shop. This growing fatigue particularly applies to chains that are subjected to severe strains. It would be well if the process for softening the crystallized metal was more generally adopted. It is a singular provision in nature that calorification has the effect of renewing the elasticity of wrought iron, and the remedy so readily applicable is often overlooked on account of its very simplicity.

Results of South African Railway Strike.

The legislators of South Africa feel at liberty to enact legislation concerning trade disputes that would send most of the members into compulsory retirement were the same thing done in any State of the United States. There was a rather serious strike among the railway employees in South Africa some time ago, and now the legislators at Cape Town are dealing out rewards and penalties. To the men who remained at work during the strike the lawmakers are rewarding with four days' special leave on full pay, and the railway men who served with the defense are to be rewarded with three days' extra pay. The strikers who returned to work will be fined one and a half days' pay for every day they remained on strike.

Questions Answered

POWER REQUIRED TO MOVE A VALVE.

R. T. M., Toledo, Ohio, asks: In the case of an unbalanced slide valve, what is the method of finding out the amount of power required to move the valve? A.—In determining the power required to move a valve, multiply the area of the valve face by the steam pressure, then deduct one-third for back pressure from the steam port and exhaust port. The friction between two smooth surfaces well lubricated varies from one-tenth to one-fourteenth of the pressure; the weight of the valve itself being slight it need not be considered. Friction is the resistance that two contacting surfaces have to being moved one over the other and is of three kinds—sliding, rotation and liquid. As an illustration, supposing that a valve measures 10 ins. by 20 ins., with 180 lbs. of pressure per sq. in. Then $10 \times 20 = 200 \times 180 = 36{,}000$, from which deduct one-third, and the result is 24,000 lbs. This amount divided by 10 will be 2,400, the amount of power in pounds required to move the valve. This strain on the valve gear will cause it to wear rapidly. This amount is lessened by the proportions of the reverse lever, in proportion to the distance between the lower connection of the reverse lever and the point at which the reach rod is connected to the lever in comparison with the distance to the end of the lever. With any length of lever the power required of the engineer in moving the lever in the case of unbalanced is very great.

SETTING UP WEDGES.

S. S., Binghamton, N. Y., writes: There are differences of opinion here in regard to the best method of setting up wedges. What in your opinion is the best method? A.—The engine should have steam up when the wedges are adjusted, because the parts of the frame that are near the fire box become heated and expand or get a little larger than when the boiler is cold. The crank pins should be on the top quarter when the wedges are set up; a block may be placed in the rail back of the wheel and the engine moved back against it, or the wheel may be pinched forward with a pinch bar, the object being to jam the driving box hard up against the shoes so that whatever lost motion there may be between the jaws will be at the back of the box, so that the wedges will slip up freely, when all the boxes are tight against the shoes set the wedges up moderately tight with a 12-in. monkey wrench. Then on the top of the wedge scribe a line on the pedestal jaw, then draw it down about ⅛ of an inch, and if there is lost motion at the head of the wedge bolt, the bolt should be screwed slightly upward again to make allowance for the lost motion. If there is another bolt passing through the pedestal jaw tighten it, and be sure that it does not extend through the wedge on the driving box. If there be any doubt, take out the bolt and measure its length. The jam nuts on the wedge bolts should be tightened with a large wrench, because the pedestal braces, or binders, are tight before setting up the wedges, and the tendency of the jam nuts to loosen is very great. It need hardly be stated that the wedges should be set up on the side only where the crank pins are on the top center, and when that side is finished the engine is then moved until the crank pins at the other side are on the top center, and proceed as before. The reason that the crank pins should be upward on the side that the wedges are being adjusted is because if the pins were on the dead center and the side rods too long or too short they would necessarily force the box against the wedge instead of the shoe, and if the crank pins were below the centers when the wheel was pinched forward, the side rod would have a tendency to draw back on the crank pin and would therefore draw the box back against the wedge.

LEFT-HAND THREADS.

P. O., Memphis, Tenn., writes: We have not a very large assortment of modern tools here, the lathes principally being of the older type. What is the proper way to cut a left hand thread on an ordinary lathe? A.—Gear up the lathe the same as for a right-hand thread, and then change the shifter on the end of your lathe. If your lathe has no shifter, put in an extra gear, so as to move the carriage from left to right. Then begin to cut the thread at the left hand and cut to right. The same method applies to outside or inside threads. Remember to set the tool above the center for outside turning and below the center for boring out or inside cutting in the case of iron or steel. In the case of brass set the tool below the center for outside turning, and above the center for boring or cutting inside work.

FITTING PISTON RINGS.

W. S., Mansfield, Ohio, writes: Will you kindly tell me what is considered the most practical method of fitting piston rings to locomotive air pumps? A.—The most practical method may be governed by shop conditions, or may be largely a matter of opinion, the most accurate method, however, is to use the proper sized ring for the cylinder for which it is intended, then remove enough metal from the ends of the ring to allow it to enter the cylinder and lap over considerably at the ends. It must then be fitted to a bearing all the way around in the cylinder, which may be done by filing down the high places or by springing it into shape. For very accurate work the rings can be entered on a form or a wooden piston with very wide grooves and be rubbed through the cylinder to find the bearing points and low places. After the correct bearing is obtained, the ends of the ring must be filed to make a perfect joint and lap over a trifle so that they will enter the cylinder with considerable friction when placed on the piston. In fitting rings to the air cylinder or small end of the differential valve piston, it is essential that the pistons fit the cylinders, that the cylinders are true, and that the rings fit the piston grooves. If standard rings cannot be obtained and it is necessary to reduce the width of the ring it must be ground to a fit as it is seldom that a satisfactory bearing can be made by filing the side of the ring.

MAKING HIGH-SPEED STEEL.

D. S. C., Wayeross, Ga., asks: Can you tell how high speed steel should be worked to obtain the best results? Sometimes our tool blacksmith gets it just right, but does not know what he does to it that time. A.—The chief causes of failure in using tool steel is overheating and overworking. The heating should be uniform in a furnace if possible. When heated the work should be done rapidly, the hammer blows being lightened as the metal cools. In hardening, the heating should be uniform and as low as will give the required degree of hardness. A tool is spoiled if the heat be variable. High heat spoils the metal, changing the fine molecules into coarse, irregular, crystalline grains, which break readily. Running streams are claimed to be the best for large tools. In tempering the heating should again be uniform and slow. It will be found that the tool brought slowly to the desired temper will stand more work than quickly tempered tools. Some kinds of steel are improved by being cooled on an air blast. Manufacturers generally furnish directions for using their special brands of steel.

BREAKING CRANK PINS.

C. D., Hoboken, N. J., writes: Some engineers claim that there is much more danger of crank pins breaking when wheels are slipping in wet weather. Is the strain greater on the crank pin when the wheels are slipping?

A.—The danger of breaking crank pins is increased when wheels are slipping, especially if sand is admitted to one rail and not to the other. Even when both are sanded there is danger at the moment of adhesion.

Heavy Mikado and Pacific Type Locomotives for the Pennsylvania Railroad Company

During the last few years the Pennsylvania Railroad Company has felt the need of a larger freight locomotive for use on the main line between Altoona and Pittsburgh, in order to reduce double-heading to a minimum and to avoid breaking up trains arriving at Altoona and Pittsburgh before sending them forward over the Pittsburgh Division. It was also thought desirable to experiment with a very heavy Pacific type locomotive for passenger service on this same division. With this object in view a Mikado locomotive, which will bear Pennsylvania Railroad classification "L-1-s," and a Pacific type locomotive, which will bear Pennsylvania Railroad classification "K-4-s," have been developed. The first "L-1-s" locomotive was placed in service about the first of May of this year, while the first "K-4-s" locomotive was placed in service about June 10 of this year.

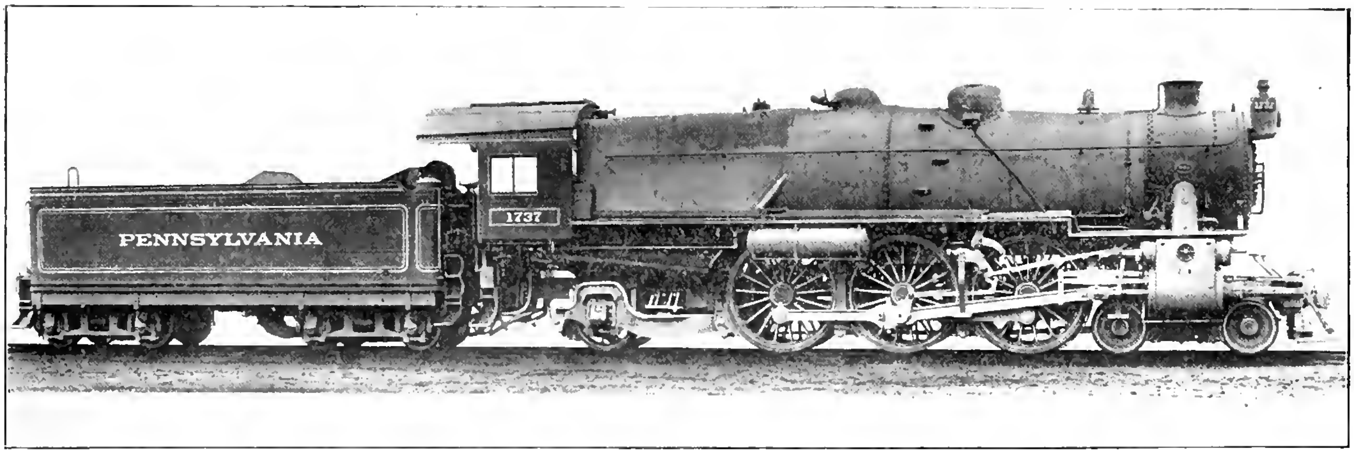
Inasmuch as the road clearance is somewhat limited, also the weight per pair of driving wheels is limited to 65,000 pounds with a five per cent. margin for scale variations and the dynamic augment of the unbalanced reciprocating parts at 70 m. p. h. is limited to thirty per cent. of the weight on the drivers, it was necessary to keep the locomotives within restricted limits and make the revolving and reciprocating parts as light as possible and at the same time maintain the necessary strength. Further, it was found desirable to maintain as many parts as possible interchangeable in these two types of locomotives and to use as many parts as possible which are embodied in the design of the E-6-s locomotives.

The following are interesting features in the designs:

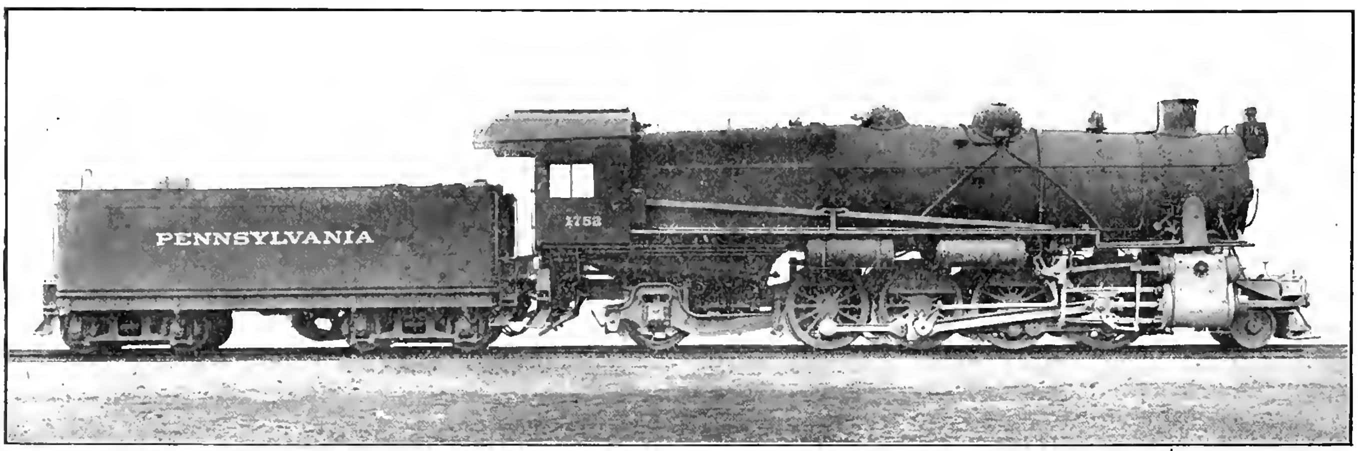
The design of boiler is particularly interesting in the type of flanging used. It will be noted that the throat sheet is flanged integral with the lower half of the rear barrel sheet. The advantages of this scheme are that it was possible to lower the locomotive about 1⅞ inches and at the same time give sufficient clearance for the rear driving wheels, the clearance being close at this point, particularly with the Pacific type locomotive. The practice of flanging the neck sheet and the barrel sheet in one piece has been followed on quite a number of the modern locomotives, also that of flanging the dome in one piece has been used to quite an extent. The boilers of the "L-1-s" and the "K-4-s" locomotives are interchangeable.

The locomotives are equipped with all-steel cabs, which are considerably smaller than the standard type of cab used on the Pennsylvania Railroad. On account of the fact that the locomotives are equipped with screw reverse gear a cab of great length is not necessary, and it is believed that the shorter cab will give the engine crews better opportunity to observe signals.

The running gear has been lightened as much as possible by the use of heat-treated material for driving axles, crank pins, piston rods and side and main rods. The axles, crank pins, wrist



PACIFIC 4-6-2 TYPE LOCOMOTIVE FOR PENNSYLVANIA RAILROAD.
Pennsylvania Railroad Company, Builders.



MIKADO 2-8-2 TYPE FOR PENNSYLVANIA RAILROAD COMPANY.
Pennsylvania Railroad Company, Builders.

pins and piston rods are provided with holes through them with a view of reducing the weight and at the same time providing a better chance for the heat-treatment to take effect.

The trailer truck is what is known as the K-W truck, this truck being interchangeable on the "E-6-s," "L-1-s" and "K-4-s" locomotives.

The driver brake arrangement is particularly interesting on account of the arrangement of cylinders, this arrangement being necessary to provide sufficient space for two 16-inch cylinders which are necessary for proper control.

The locomotives are equipped with Schmidt smoke tube superheaters and Security fire brick arch.

COMPARISON OF TENDERS.

P. R. R. Classification	H9s	L1s
Tank	Water bottom	Water bottom
Wheels, diam..	36"	36"
Journals, diam. and length...	5½" x 10"	5½" x 10"
Water capacity	7,000 gals.	7,000 gals.
Coal capacity..	25,000 lbs.	25,000 lbs.
Height of floor above rail...	66"	66"

COMPARISON OF CLASS L1S AND H9S LOCOMOTIVES.

Type	Consolidation	Mikado
P. R. R. Classification..................	H9s	L1s
Gauge	4' 9"	4' 9"
Service	Freight	Freight
Fuel	Bit. coal	Bit. coal
Tractive power—M. E. P. = $\frac{4}{5}$ boiler pressure, pounds	46,290	57,850
Estimated total weight in working order, pounds	250,000	330,000
Estimated total weight on drivers, pounds	220,000	262,000
Wheel base—Driving	17' 0½"	17' 0½"
Wheel base—Total	25' 9½"	36' 4½"
Wheel base—Engine and tender........	62' 5⅞"	72' 3"
Tractive power × diameter of drivers ÷ total heating surface*............	683	622.0
Total heating surface* ÷ grate area....	76.21	82.38
Firebox heating surface ÷ total heating surface*, per cent.	4.45	5.05
Volume both cylinders, cubic feet......	15.91	19.88
Total heating surface* ÷ volume both cylinders	264.1	290.0
Grate area ÷ volume both cylinders..	3.46	3.52
Kind of cylinders......................	Simple	Simple
Diameter and stroke of cylinders.......	25" x 28"	27" x 30"
Spread of cylinders....................	90"	90"
Kind and size of valves................	12" piston	12" piston
Greatest travel of valves..............	6"	6"
Outside lap of valves..................	⅞"	⅞"
Driving wheels, diameter over tires....	62"	62"
Driving wheels, thickness of tires......	3½"	3½"
Driving axle journals, main, diameter and length	10½" x 13"	11" x 15"
Engine truck wheels, diameter.........	33"	33"
Engine truck journals, diameter and length	5½" x 10"	6½" x 12"
Trailing truck wheels, diameter........	....	50"
Type of boiler.........................	Belpaire	Belpaire
Working pressure, pounds.............	205	205
Outside diameter of first course in barrel	78½"	78½"
Firebox, width and length.............	72" x 110¼"	80" x 126"
Firebox plates, thickness..............	⅜" & 5/16"	⅜" & 5/16"
Firebox water space...................	5"	5"
Tubes, number and outside diameter....	265—2"	237—2¼"
Superheater flues, number and outside diameter	36—5⅜"	40—5½"
Tubes, thickness	.125"	.125"
Superheater flues, thickness............	.148"	.148"
Tubes, length	180"	228"
Heating surface tubes, saturated, sq. ft..	2,841.2	3,746.8
Heating surface firebox, saturated, sq. ft.	187.0	288.6
Heating surface, total, sq. ft...........	3,028.2	4,035.4 } 5,189.3
Superheater heating surface, sq. ft.....	782.2	1,153.9 }
Grate area, sq. ft......................	55.13	70.0
Dome, height above rail................	180"	180"
Center of boiler above rail............	9' 9"	9' 9"
*Equivalent heating surface, sq. ft....	4,201.5	5,766.3

COMPARISON OF CLASS E6S AND K4S LOCOMOTIVES.

Type	Atlantic	Pacific
P. R. R. Classification..................	E6s	K4s
Gauge	4' 9"	4' 9"
Service	Passenger	Passenger
Fuel	Bit. coal	Bit. coal
Tractive power—M. E. P. = $\frac{4}{5}$ boiler pressure, pounds	29,427	41,845
Estimated total weight in working order, pounds	240,000	305,000
Estimated total weight on drivers, pounds	133,100	200,000
Wheel base—Driving	7' 5"	13' 10"
Wheel base—Total	29' 7½"	36' 2"
Wheel base—Engine and tender........	63' 10½"	71' 10"
Tractive power × diameter of drivers ÷ total heating surface*............	599.00	580.50
Total heating surface* ÷ grate area....	71.30	82.38
Firebox heating surface ÷ total heating surface*, per cent.	4.93	5.05
Volume both cylinders, cubic feet......	13.10	18.55
Total heating surface* ÷ volume both cylinders	300.00	310.80
Grate area ÷ volume both cylinders....	4.21	3.77
Kind of cylinders......................	Simple	Simple
Diameter and stroke of cylinders.......	23½" x 26"	27" x 28"
Spread of cylinders....................	85½"	89"
Kind and size of valves................	12" piston	12" piston
Greatest travel of valves..............	7"	7"
Outside lap of valves..................	1 5/16"	1 5/16"
Driving wheels, diameter over tires....	80"	80"
Driving wheels, thickness of tires......	4"	4"
Driving axle journals, main, diameter and length	9½" x 13"	11" x 15"
Engine truck wheels, diameter.........	36"	36"
Engine truck journals, diameter and length	6½" x 12"	6½" x 12"
Trailing truck wheels, diameter........	50"	50"
Type of boiler.........................	Belpaire	Belpaire
Working pressure, pounds.............	205	205
Outside diameter of first course in barrel	78½"	78½"
Firebox, width and length.............	72" x 110¼"	80" x 126"
Firebox plates, thickness..............	⅜" & 5/16"	⅜" & 5/16"
Firebox water space...................	5"	5"
Tubes, number and outside diameter....	242—2"	237—2¼"
Superheater flues, number and outside diameter	36—5⅜"	40—5½"
Tubes, thickness	.125"	.125"
Superheater flues, thickness............	.148"	.148"
Tubes, length	180"	228"
Heating surface tubes, saturated, sq. ft..	2,660.5	3,746.8
Heating surface firebox, saturated, sq. ft.	195.7	288.6
Heating surface, total, sq. ft...........	2,856.2	4,035.4
Superheater heating surface, sq. ft.....	721.0	1,153.9
Grate area, sq. ft......................	55.13	70.0
Dome, height above rail................	180"	180"
Center of boiler above rail............	9' 10"	10' 1"
*Equivalent heating surface, sq. ft....	3,937.7	5,766.3

Tenders are the same as on Class "L1s" locomotive.

Compliment Paid Long Ago to George Westinghouse.

At the Air Brake Association convention held in Detroit in 1899 Mayor Maybury made a welcoming address in which he said:

The work of George Westinghouse is great. It will live on and will give him honor even when he is gathered to his fathers. We go to the cities of the world where great monuments are erected. We read the inscriptions and learn that this monument was erected to this man because upon some field so many were murdered, so many died; but the monument which you people are erecting is, to my mind, far the greatest. I would not detract from the valorous deeds of war, but the time is coming in this world when there will be erected monuments upon greater and stronger principles than that. The things which they accomplish for the good of humanity and which will live after them, these are the monuments of the future, in my judgment; and all honor to the men who build!

Hudson Terminal Traffic.

During the year ending with March the passenger traffic through the Hudson Terminal was 30,535,500. There was an average of 5,818 trains a week, with 101 passengers in each.

Catechism of Railroad Operation

NEW SERIES.

Beginning Third Year's Examination.

(*Continued from page 212, June, 1914.*)

Q. 10.—What are the duties of the slide or piston valves?

A.—The main valves (slide or piston) control the admission of steam to the cylinders and the exhaust of steam from cylinders to atmosphere after the steam has done its work in cylinder.

Q. 11.—What is steam lap?

A.—Steam lap is the amount or distance the steam edge of valve face overlaps the steam edge of admission port, when the valve is in mid position (or on center of its seat).

Note.—The edge of valves face or ring by which the steam flows on its way to cylinder is termed the steam edge of valve and the edge of admission port, over which steam flows as it passes into cylinder, is called the steam edge of admission port. The edge of valve face or ring by which steam flows from cylinder to the exhaust is called the exhaust edge of valve, and the edge of admission or steam port over which steam passes from cylinder is termed the exhaust edge of port.

Q. 12.—What benefits are derived from the steam lap feature of valve?

A.—Steam lap enables us to get an early cut off of steam entering the cylinder and to retain the steam in cylinder getting work from the expansion of the steam.

Q. 13.—What is meant by lead?

A.—Lead is the amount the admission port is open for admission of steam to cylinder at time piston is ready to begin its stroke.

Q. 14.—What is the object of lead?

A.—To admit steam to cylinder just as piston completes its stroke, in that manner cushioning piston and bringing it gradually to rest, relieving reciprocating parts of excessive strain and wear. It also gets the power into cylinder to push piston on return stroke the moment crank pin passes the dead center.

Q. 15.—Is lead beneficial on all classes of engines?

A.—No.

Q. 16.—On what class of engines is it invaluable?

A.—On engines running at a high speed.

Q. 17.—Why is lead not good for engines at slow speeds?

A.—Because steam is admitted to cylinder before piston completes stroke and acts as a resistance to piston's movement, overcoming its equivalent in power exerted on opposite side of piston.

Q. 18.—Is the lead the same at all points of cut-off on all engines? Explain.

A.—No. The Stephenson valve motion has the amount of lead increased as cut-off is shortened, account of influence of the eccentrics. The Walschaert and Baker Pilliod valve gears give a constant lead at all points of cut-off because the lead is controlled by connection to crosshead, the movements of which do not vary.

Q. 19.—How much lead is generally given on Stephenson valve geared engines, and about what is the amount of its increase at shortest cut-off?

A.—On most of the modern engines the valves are set line and line at full stroke, or if any lead is given it is merely the width of a line and the increase from this to the short cut-off is about three-sixteenths of an inch on the average engine, but it may vary some on account of difference in methods of construction and adjustment of parts.

Q. 20.—How much steam lap is generally given in construction of valves?

A.—This depends entirely on the ideas of heads of mechanical departments on different roads and varies from five-eighths of an inch on some roads to one and one-fourth inches on other roads and classes of service. The amount of lap being determined by experiments and calculations to obtain best results.

Q. 21.—What is exhaust lap?

A.—Exhaust lap is the amount the exhaust edge of valve's face overlaps the exhaust edge of admission port when valve is in mid position or on center of its seat.

Q. 22.—On what class of engines is exhaust lap considered a benefit?

A.—On engines in very slow speed service handling heavy trains on long grades.

Q. 23.—What is the effect of exhaust lap and why is it beneficial in slow speed service?

A.—Exhaust lap delays the exhaust getting greater expansion of steam and consequently saves water and fuel. It also hastens compression and makes the engine logy.

Note.—Exhaust lap is only beneficial at a speed where exhaust has ample time to escape from cylinder through the restricted port opening.

Q. 24.—What is exhaust clearance?

A.—It is the amount the admission ports are open to the exhaust when valve is in mid position.

Another Answer.—It is the distance the exhaust edges of valve lack of touching the exhaust edges of the admission ports when valve is on center of its seat.

Note.—"Exhaust clearance" is often called "exhaust lead."

Q. 25.—What is the object in giving valve exhaust clearance? What does it do?

A.—To reduce resistance to movement of piston in cylinder on high speed engines making them smarter and more speedy.

Exhaust clearance gets exhaust open earlier and keeps it open longer in that manner reducing the back pressure and delaying compression.

Q. 26.—Is "exhaust clearance" a benefit or detriment from economical point of view? Why?

A.—It is a detriment and sacrifices water and fuel that speed may be gained. It is an expensive feature from economical standpoint because it does not get the expansion of the steam, account of allowing it to be exhausted while still at high pressure in cylinder.

Q. 27.—What is the approximate amount of lead given engines equipped with the Walschaert and Baker Pilliod valve gears?

A.—It is from about three-sixteenths to seven thirty-seconds of an inch on most engines, although many roads are still experimenting to determine the proper amount of lead to get best results in different classes of service.

Q. 28.—Name the events (different actions or occurrences taking place) during stroke of piston.

A.—Admission, cut off, expansion, exhaust or release (during which time we have back pressure) and compression.

Note.—The resistance of exhaust steam called "back pressure" obtains during the release and is so considered an "event" of the stroke, because it is co-relative with exhaust.

Q. 29.—What is back pressure?

A.—"Back pressure" is the resistance of exhaust steam to the piston during time the exhaust is open.

Note.—This resistance is caused by friction of current of exhaust steam on walls of channels and restricted openings in nozzle tips through which it passes.

Q. 30.—What is compression?

A.—"Compression" is the resistance (to the piston) of steam confined in the cylinder after the exhaust closes.

Note.—"Compression" begins at point where "back pressure" ends, that is at time the opening from cylinder to exhaust is closed, trapping some steam in cylinder ahead of piston.

Q. 31.—Name and describe the two general classes of main steam valves in use.

A.—The "outside" admission valve, which may be either a piston or slide valve, is one which admits steam to cylinder by its outer edges and exhausts steam from cylinder by its inner edges.

The "inside" admission valve is a piston valve which admits steam to the cylinder by its inner edges and exhausts steam from the cylinder by the outer ends or edges of the valve.

Q. 32.—What is a balanced slide valve?

A.—A balanced slide valve is one which has the pressure kept off the greater portion of its upper surface.

Another answer.—A balanced slide valve is one so constructed that the pressures on top of valve are about equalized with the pressures on under side of valve.

Note.—About sixty-five per cent. of the upper surface of valve is protected from the pressure—the pressure allowed on the balance of thirty-five per cent. of its upper surface being necessary to overcome the influence of the exhaust and steam pressure against face of valve over admission port at end of where steam is present.

Q. 33.—How is a slide valve balanced?

A.—It is balanced by placing strips of metal in suitable grooves cut in top of valve near its outer edges. These metal strips are held up by elliptical or coil springs (and by steam pressure in chest) against the pressure or balance plate (which is attached to or cast on the cap of chest), forming a steam tight joint excluding steam from top part of valve enclosed by the balance strips.

Q. 34.—What is small hole drilled in crown of valve for and what is it called?

A.—This hole is to allow any steam which might get on top of valve by defective balance strips, to pass to exhaust and atmosphere, in that manner maintaining the balanced feature of valve, and it is called the "release port."

Q. 35.—Why are valves balanced?

A.—To reduce friction.

Q. 36.—How does the Allen valve differ from the plain "D" type slide valve?

A.—The Allen valve has a supplementary port extending from one face of the valve up and over through crown of valve to the other face.

Q. 37.—What is the object of the supplementary port in the Allen valve?

A.—It is to get a more rapid admission of steam to the cylinder at the beginning of stroke of piston and it gets the full port opening in about one-half the time the plain "D" type valve would give it.

Note.—Most heads of mechanical departments do not consider that the Allen valve gains anything along economical lines in practice.

Q. 38.—Describe the piston valve.

A.—The piston valve is a cylindrical spool shape device, with metallic packing rings fitted in suitable grooves cut in the outer surface of the heads at each end, these packing rings forming a steam tight joint with walls of bushing in valve chamber and determining the steam and exhaust edges of valve face.

Q. 39.—How many ports in steam chest for an outside admission valve, and what are the names and duties of these ports? Naming them as arranged.

A.—Five ports. The two outer end ports are called supply ports, because the supply of steam from boiler to steam chest comes through them; the next two ports are called admission ports, because steam is admitted to the cylinder through them; the central port is called the exhaust port because steam is exhausted to atmosphere through it after being used in cylinder.

Q. 40.—How many ports in valve chamber for an inside admission valve? Name them in order of arrangement.

A.—Five. The two outer ports are the exhaust ports, the next two are admission ports, the central port is the supply port.

Q. 41.—Trace the flow of steam from the boiler to the atmosphere in a saturated steam locomotive.

A.—The steam passes from dome, through throttle box, stand pipe, dry pipe, tee or nigger head, steam pipes, steam channels or ways in cylinder saddle casting, supply ports, steam chest, and admission ports to cylinder, after it has done the work in cylinder it passes from cylinder through admission port, exhaust cavity in valve, exhaust port, exhaust channel in cylinder saddle casting, nozzle base, or nozzle box, nozzle tips, petticoat pipe and stack to the atmosphere.

Q. 42.—Trace the flow of steam from boiler to atmosphere in a superheated steam locomotive.

A.—The steam passes from dome through throttle box, stand pipe, dry pipe, top or saturated steam header, superheater return pipes in large tubes or flues, lower or superheater header, thence through the supply pipes and supply ports to valve chamber or steam chest, then it enters admission ports to cylinder. After performing work it passes from cylinder through same admission port it entered cylinder through, by end of valve (for inside admission valve) or through exhaust cavity of valve (for outside admission), to exhaust ports, exhaust channels, exhaust base, exhaust nozzles or tip, petticoat and stack to atmosphere.

Q. 43.—Explain how the power of the steam is transmitted from cylinder to driving wheels in a locomotive.

A.—The movement of valve admits steam to one end of cylinder where it exerts its influence or power on the piston head and the power is transmitted through the piston head, piston rod, crosshead, wrist pin, main rod and main crank pin to main driving wheel causing it to revolve.

Hot Boxes.

In a recent discussion on the subject of hot boxes, Mr. George F. Laughlin, president of the Car Foremen's Association of Chicago, and general superintendent of the Armour car lines, said that he had investigated the subject of packing boxes and had largely eliminated the trouble, and not only so, but had accumulated waste, as there is almost always more taken out of the box than is required to properly repack it. "It is a very hard matter to keep the oiler from putting too much in the box and you have got to labor with him always, and you have almost got to fight with him to keep him down to the proper amount. Our experience has been that there has been more trouble with too much waste in the box than any other thing. I recall one instance several years ago when we had a number of hot boxes over a certain line and I finally invited their general foreman down to go over the matter with our force. We had been doing everything we could, using the best oil and the best waste we could get. He came down and I took him out into the yard and he went along with the oilers and took out, I would say, a bucket and a half of packing from the train for his company. When we went to lunch, I had our inspector follow the cars up to his railroad yards and see how they were running, and his oilers put about that much packing into the boxes again. That was the difference between his oilers' opinions and his opinion, and as a general proposition I think you will find the oilers put too much packing in."

Efficiency in Railroading.

In 1913 the Pennsylvania Railroad Company made more than two million efficiency tests, in 99.9 per cent. of which the workmen were found to be observing the strict letter of the rules. It made more than sixteen thousand tests of the regularity with which the enginemen obey flagman's signals, and found only eleven cases in which the men failed in their duty. It made 133,000 observations of the way in which rules for handling explosives and inflammables were obeyed, and found only 152 infractions.

Many fireboxes have badly fitting grates which admit air when it is highly injurious. No advantage results from currents of air rushing through the sides and ends of grates for the reason that it does not promote combustion but has the opposite effect.

Elements of Physical Science

By JAMES KENNEDY

XVI. MOTIVE POWER.

There are a number of powers which produce motion, the best known of which are gravity, the elastic force of springs, the muscular strength of man and of animals, the force of wind, water, steam and electricity.

The power of gravity is applied by attaching weights to machinery, the downward tendency of the weights keeping the machinery in motion, as in some kinds of clocks. When there is not room for weights, a coiled spring of elastic substance produces motion by a constant effort to unbend itself.

Man can produce a certain degree of motion with his own strength, but the result is not great without assistance, one horse being reckoned as equal to five men. Much more powerful forces are found in wind or water. The irregularity of wind power is a serious drawback to its use. Water power is also subject to variations, but there is less difficulty in water power than from the variations of the wind.

The greatest of all powers used by man is steam, the vapor generated by submitting water to a high degree of heat. There is no limit to steam power, its use being limited to the degree of resistance of the vessel in which it is enclosed. Its application to machinery marked an epoch in the world's history. Its properties and applications will be considered in the chapter on elastic fluids. Of the force of electricity we shall also treat in its proper place, but it may be stated that this great and mysterious force is developed by friction, by chemical action, by magnetism, and by heat.

XVII. RESISTANCE.

The most common form of resistance is that of a weight to be moved with reference to work of any kind. An established unit of work is raising one pound through the space of one foot. From this basis any degree of resistance can be readily calculated. A horse power consists in the raising of 33,000 pounds one foot in one minute. Friction adds to the resistance of all bodies being moved, as when a weight is being dragged over the ground. In machinery the rubbing of the different parts together is always an important factor, adding to the degree of resistance. In this latter connection it may be stated that the friction of a body is much greater when it commences moving than after it has been moving for a time. Friction is lessened by smoothing and polishing the surfaces, and by putting grease and other lubricants between the surfaces. Finely powdered plumbago and graphite are among the best articles used for this purpose.

It should be noted that friction has its advantages. Without friction the driving wheels of a locomotive would turn on the rails without moving the locomotive forward, and without friction men could not walk. When friction is lessened, as on ice, we walk with difficulty.

XVIII. MACHINES.

All machines are instruments used to aid the power in overcoming resistance. Tools such as chisels, saws and hammers are simple machines, and, like engines and other machines of great power, they merely aid the power in its action. They do not create power. All machines remain at rest until acted on by some motive power, and whatever a machine gains in amount of work it loses in time, and what it gains in time it loses in amount of work. This can be readily seen in the use of the crowbar, by which weights may be slowly moved, although much heavier than a man is able to lift.

Machinery not only enables us to use our power much more conveniently, but it enables us to use other motive powers besides our own strength. The limit of the power of machinery is the strength of the materials of which it is made. Machines that will work well in small models, sometimes fail when made in full size, because when the resistance is increased and their own weight is added, the material will not stand the strain.

XIX. STRENGTH OF MATERIALS.

The determining of how great a strain certain materials will bear, and how they may be joined together to the best advantage, is of the utmost importance in practical mechanics. The relative strength of materials has already been briefly treated of, and it may be added that rods and beams of the same materials and uniform size resist breakage in the direction of their length with degrees of strength that vary in a ratio to the areas of their ends. If two rods of equal length and thickness are used in sustaining a weight, it will be found that by increasing the area of the end of one rod it will sustain increased weight. The strength of a horizontal beam supported at each end diminishes as the square of its length increases. It is most easily broken in the center, and if a beam of uniform strength is required, it should taper from the middle towards the ends.

It should be noted that a given quantity of material has more strength when disposed in the form of a hollow cylinder than in any other form than can be given it. Nature teaches us fine lessons in the construction of bones and the tubes of feathers, where the elements of strength and lightness are combined in an eminent degree. This wise economy in nature is skilfully followed by engineers in the construction of metal supporting columns, and even in heavy shafting it is readily found that a hollowing out of the metallic mass increases its strength while lightening the weight of material.

Mysteries of the Steam Engine.

There are certain things connected with the development of the steam engine that are mysteries which no one will ever be able to explain. Some discoveries and improvements that made the steam engine successful have been due to accident, some to necessity and others to induction. Of the first steps in the upward progress—the discovery of combustion or fire, the expansion of water into steam under the influence of heat, and the availability of this expansive force for the performance of useful work, we have no historical record whatever. Imagination can conceive the lesson learned about the force arising from boiling water when some ancient housewife tried to keep the rich flavor inside the boiling pot by making the lid airtight and holding it down with a stone, but how far the resulting explosion spread useful knowledge remains a mystery.

Philippine Railway Extension.

Railway construction in the Philippines is being continued only in line with the plans and prospects outlined in reports about a year ago and new enterprises are not being undertaken. Within the scope of plans being realized, the chief interest centers in the approaching completion of the Manila Railway to Baguio, the mountain capital. On this branch the grading has been practically finished and the track has been laid up to the foot of the first rack grade, where the cog-road section begins. This latter section climbs a 14 per cent. grade for 10 miles through magnificent mountain scenery. On the entire branch there are to be five tunnels approximating a total length of 0.932 mile, of which the longest is 0.262 mile. One tunnel is practically completed, the headings having been driven through on three and a start made on the fifth. All the material for the cog road is now on the ground and work started about April 1. From present indications it is expected that the road will be ready for traffic in 1916.

Air Brake Department

Brake Efficiency.

At a recent meeting of the Central Railroad Club at Buffalo, N. Y., Mr. W. V. Turner prepared and read a paper entitled, "Air brakes; why their possible utility and performance is not obtained in a higher degree in actual service."

This is largely an effort on the part of Mr. Turner to set forth to all concerned that the air brake must be considered as a whole, instead of in parts, when an increase of efficiency, improvement or maintenance is in question, and in his opinion it is not stretching matters to claim that the brake begins with the rail and ends with the angle cock on the rear car and that perhaps it should also include the manipulator as part of it.

The paper deals with up-to-date brake apparatus, and is of course too lengthy to reprint in these columns, but there is some information contained which we wish our readers to have, and particularly because a number of prominent railroad men and air brake experts have pronounced it the best air brake paper that has ever been read before a railroad club.

Mr. Turner asks that air brake failures or troubles be traced to their true cause before any remedy is fixed upon, as the true cause or disorder is frequently far different than the apparent defect, for by knowing the cause only can a remedy be provided.

He first gives the "Basic requirements of an automatic brake" which he defines as follows:

The automatic air brake is a device for controlling railroad trains, dissipating in the form of heat produced by frictional work the kinetic energy which they possess by virtue of their weight and motion. A satisfactory brake must possess, 1. Reliability, 2. Flexibility, 3. Effectiveness.

1. Reliability of certainty of operation is a fundamental requisite, depending upon correct design and reasonably good maintenance, the essential principle being that any variation from normal condition must tend toward an automatic application of the brake, and not to render the obtaining of a brake application when desired less certain.

2. Flexibility involves an extension of time in which to obtain predetermined braking forces and the ability to vary those braking forces up or down, the extension of time being a function of,

(a) Range between zero braking force and maximum braking force.

(b) Proportion of reservoir and brake cylinder volumes.

(c) Low degree of braking force per unit of brake cylinder pressure.

3. Effectiveness involves,

(A) Service—

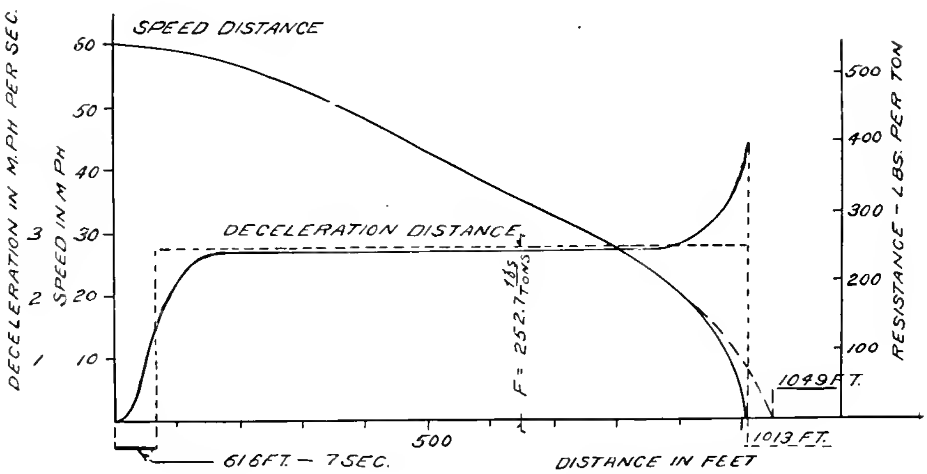
(a) Maximum degree of braking force with flexibility requirements mentioned above.

(B) Emergency—

(a) Elimination to the last degree of the time required to transmit the application from one end of the train to the other and of the time required to obtain maximum brake forces on individual cars.

(b) Degree of braking force obtained and maintained.

UNIVERSAL EQUIPMENT.
TRAIN CURVES.
ELECTRIC EMERGENCY. ROAD AND RACK TESTS.
—— PLOTTED FROM CALCULATIONS MADE FEB. 1, 1913.
---- PLOTTED FROM ACTUAL STOP MADE MAR. 18, 1913



Flexibility is obtained in present brake installations by,

1. Extending the time required to make a service brake application over a period of 5½ seconds (minimum) to 6½ seconds (maximum).

2. Fixing a range of 24 lbs. between the initial and final brake pipe pressure required to obtain this full service braking force.

3. Proportioning this auxiliary reservoir volume to the brake cylinder and clearance volumes, with a predetermined piston travel so that the theoretical equalization pressure of the auxiliary reservoir and brake cylinder, from 84 lbs. initial brake pipe pressure will be 60 lbs.

Note: (A) Any desired increase in braking force for, (1) Service brake application must be obtained by an increase in the brake pipe pressure on account of the requirements of flexibility (service brake).

(2) Emergency applications by additional brake cylinders or increase in the reservoir volume for emergency applications only, or an increase in the initial pressure carried, also for emergency only.

(B) The ratio of auxiliary reservoir volume to brake cylinder volume being fixed by,

(1) The diameter of the brake cylinder.

(2) By the predetermined and (assumed) fixed piston travel.

(3) By the fall of pressure permitted in the auxiliary reservoir.

Such a fixed leverage ratio (multiplication of total brake cylinder force, effective at the brake shoes) should be established as will properly provide for lost motion, defects, etc., in all parts involved. That is, so that sufficient clearance between the brake shoes and wheels will be insured. (Compensation for brake shoe wear is a matter of maintenance, either manual or automatic.)

(C) From the preceding it follows,

(1) The apparatus employed in connection with the automatic brake should satisfy the above requirements.

(2) Any additions to, or modifications of, this apparatus should conform to and maintain unimpaired the basic requirements above outlined.

(D) The relations stated will hold strictly true (within the narrow range of variations permissible in any mechanical

contrivance of this character), for full equalization provided the apparatus is in proper working order.

For graduated brake applications short of equalization a greater variation in the results will be obtained on account of circumstances entirely beyond mechanical control.

Variation in resultant operation may be caused by the apparatus not being in proper working order caused by,

(1) Lack of maintenance.

(2) Defective equipment.

(3) Additional equipment not consistent with the existing apparatus conforming to basic requirements outlined above.

(4) Trains too long for type of apparatus used.

(5) Make-up of trains (loads and empties).

(6) Slack between cars.

The preceding can be formulated into the following concrete statements:

That to handle trains without great risks of shocks, and with sufficient degree of latitude for the engineer's judgment, to minimize the bad effect of the time lapse between brake applications on different vehicles, and for other adverse conditions it is necessary that the retarding forces be obtained gradually and that the maximum be comparatively low. This latter, not only for the reasons given above, but also to keep the risk of wheel sliding at a minimum for service applications, and to insure a reserve of sufficient additional force for emergency stops.

That 90 per cent. braking power for service applications (that is ordinary stops) has been the generally accepted limit (and is the standard to-day for practically all roads in the country), and the range of reduction over which this is spread for a proper degree of flexibility is 24 lbs. and the time in which it is done is 6 seconds.

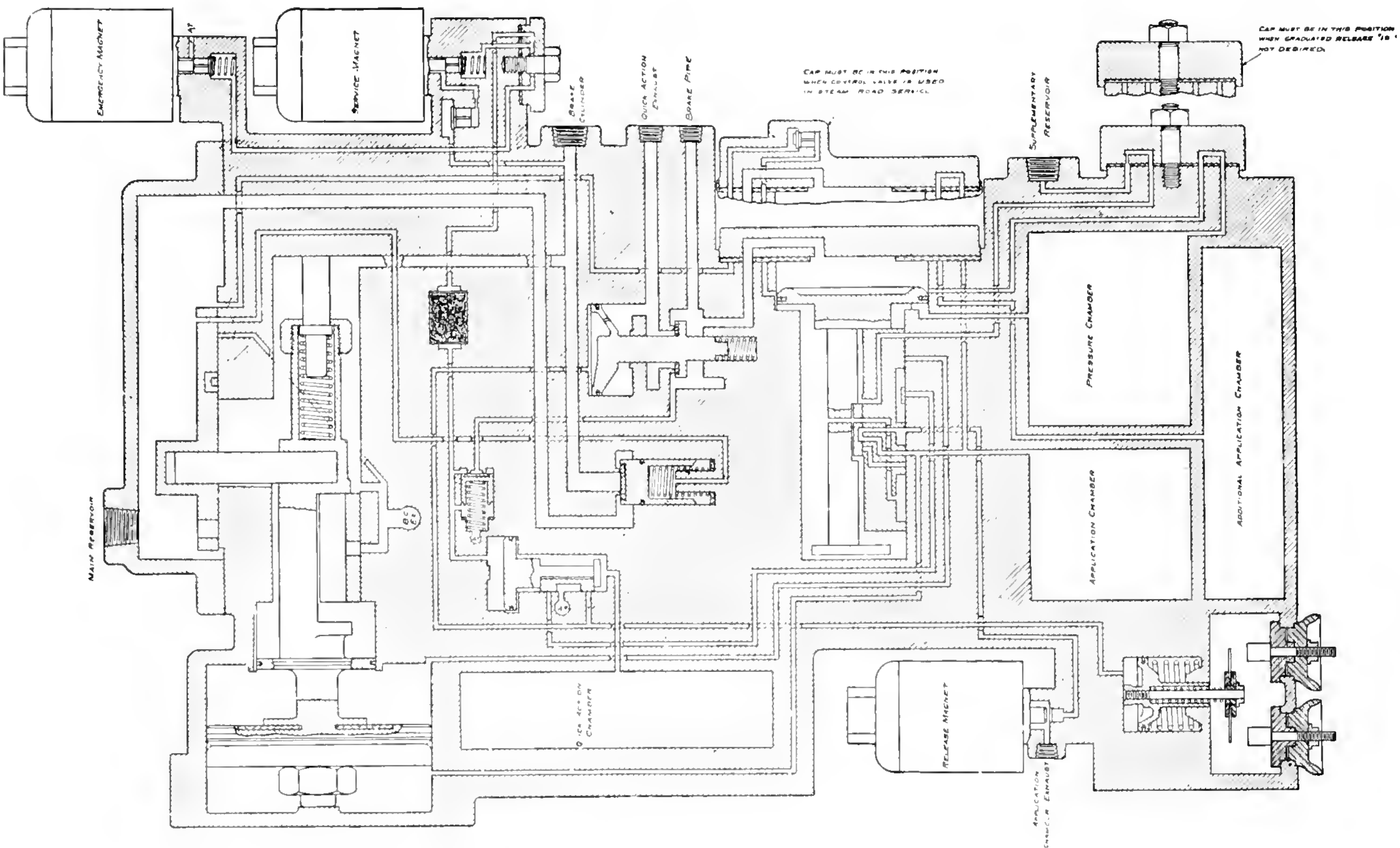
With the above accepted, any increase in the emergency brake must come from, first, an increase of initial pressure carried; second, by brake piston area added; third by an additional reservoir volume added—for emergency brakes only. (Of course, a combination for any two or all three of these methods may be used).

These have been the underlying principles of air brake design and installation for the past 40 years, and practically all its philosophy emanates therefrom and is contained therein.

To answer the question, which naturally occurs to one, why not change this standard since it has been in existence for 40 years, it is asserted that this standard is as necessary for present conditions as it was for those for which it was designed, since brake applications are more frequently required, trains longer and vehicles much heavier. Therefore it is a self-evident proposition that extreme flexibility is imperative, if rough handling is to be avoided. If any change whatever is made, it should be made in the direction of obtaining the braking force even more gradually than at present, unless simultaneous action of the brakes is assured by electric transmission.

Mr. Turner follows this with an analysis of the factors affecting brake performance, and in connection therewith submits a table of more than passing interest, and we trust that the reader who is interested in air brakes will study the table as it cannot be comprehended at a glance or first reading.

By the way of an explanation we may say that it is now possible to calculate so closely the distance in which a train of cars can be stopped from various rates of speed, all the factors entering the problem being known, that the calculated or estimated stops are within very few feet of the actual stop. As an example, calculations made February 1, 1913, on a stop of a 12 car train from a speed of 60 miles per hour on a level track with an electric emergency of the Universal Equipment figured up mathematically that the stop should be made in 1,013 feet distance and the actual stop under the calculated conditions was made on March 18, 1913, in 1,049 feet distance, which goes to show that the factors entering a stop of a train of cars with an air brake are now pretty well analyzed and



DIAGRAMMATIC ASSEMBLY OF CONTROL VALVE.

understood by air brake men. The difference of 30 feet is due to a miscalculation of the braking effect of the locomotive.

In connection with the table which follows, it may be well to state that the best single car break away stop that was made during the Pennsylvania-Westinghouse tests at Absecon in 1913, was in 725 feet from a speed of 60 miles per hour, with an emergency application of the electro-pneumatic equipment and the clasp type of brake rigging with flanged brake shoes.

It will then be understood that the ideal stop of 480 feet in the table is the best that could be made if the brake was 100 per cent. efficient all around, or rather if the retarding effect was just short of the rail friction from the instant of brake valve movement to the stop, but the next line shows that the best stop to be expected is 851 feet using 150 per cent. braking ratio. In the stop of 725 feet actually made, 180 per cent. braking ratio was employed.

It will be understood that the object of the table is to show the effect of a decrease in brake rigging efficiency, co-efficient of friction or per cent. of braking ratio, increases the length of the distance required for a stop from a 60 mile per hour speed.

The lower table is self explanatory, and a little study of it will manifest why electric current is desirable in some instances and undesirable in others, or rather undesirable and unnecessary until other conditions warrant its use. The real object of the table is, however, to show the amount of braking ratio required to compensate for deficiency in brake rigging and other factors.

TABLE No. 1.

SPEED 60. M. P. H.

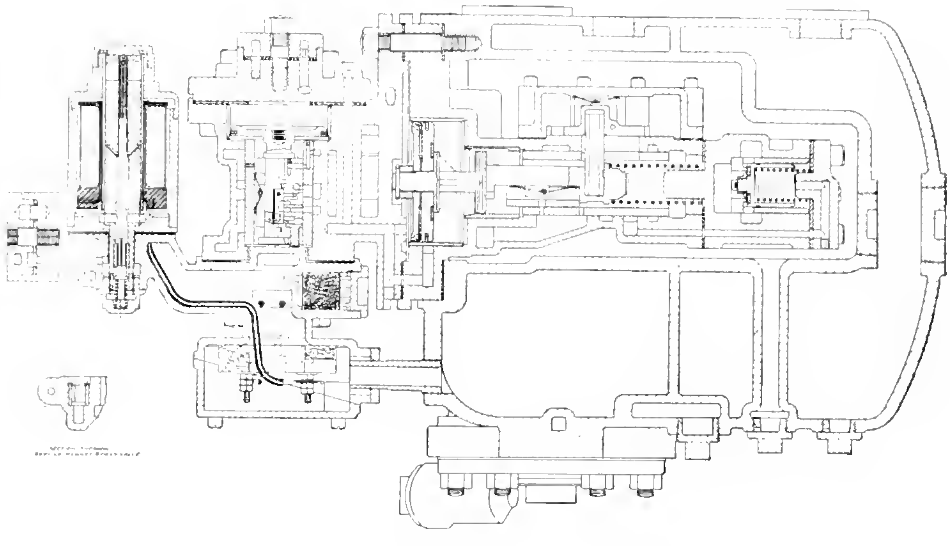
SINGLE CAR BREAKAWAY STOPS.

Brake Rigging Efficiency in Per cent.	Coefficient of Friction	Time to Apply Brakes Fully	Percentage Braking Ratio	Length of Stop in Feet	Remarks.
100	.25	0	100	480	Ideal brake. Distance to which stop is limited by adhesion of rail and wheel.
95	.11	2	150	851	Best stop to be expected in actual service.
85.5	.11	2	150	939	10% decrease in rigging efficiency, 10.3% increase in length of stop.
95	.10	2	150	930	9.1% decrease in coefficient of friction, 9.3% increase in length of stop.
95	.11	5	150	969	150% increase in time to apply brakes, 13.9% increase in length of stop.
95	.11	2	125	1005	16.7% decrease in braking ratio, 18.1% increase in length of stop.
85	.10	2	150	1027	10.5% decrease in rigging efficiency, 9.1% decrease in coefficient of friction, 20.7% increase in length of stop.
85	.10	5	150	1148	10.5% decrease in rigging efficiency, 9.1% decrease in coefficient of friction, 150% increase in time to apply brakes, 34.9% increase in length of stop.

TABLE No. 2.

SPEED 60 M. P. H. TRAIN STOPS.

Brake Rigging Efficiency in Per cent.	Coefficient of Friction	Secs. to Apply Brakes Fully	Length of Stop in Feet	Percentage Braking Ratio Train	Percentage Braking Ratio Cars
95	.11	2	1200	103	105
80	.11	2	1200	122	134
95	.10	2	1200	113	120
95	.11	5	1200	116	125
80	.10	5	1200	151	180



LONGITUDINAL SECTION OF ELECTRICALLY OPERATED CONTROL VALVE.

This table develops the folly of expecting a desired stop from an arbitrarily fixed per cent. of braking ratio. It quite as emphatically demonstrates why one may be justified, in fact compelled, by the force of the specification to specify in one case, 180% braking ratio and in another, 125, since either of these two will stop the train in the same distance, the reason being that the net gain in transmission in the one case is so much greater than in the other.

Mr. Turner then touches upon the factors affecting brake design, as in the basic design of the brake, outlining all of the factors entering into the design of the brake and for the benefit of our air brake students we quote:

The car weight times the braking ratio specified gives the total pressure.

The piston travel divided by the shoe clearance gives the leverage ratio.

The total shoe pressure divided by the leverage ratio will give the total cylinder pressure required.

The total cylinder pressure divided by the unit cylinder pressure will give the area of the piston, which fixes the size of the cylinder.

The volume of the cylinder multiplied by the unit cylinder pressure and divided by the range of flexibility will give the volume of the auxiliary reservoir.

The unit cylinder pressure plus the range of flexibility will give the necessary auxiliary reservoir pressure which fixes the brake pipe pressure to be carried.

The total cylinder pressure with the total shoe pressure and fiber stresses to be permitted gives all the necessary information that is required to design the foundation brake gear, the particular form which this shall take depending upon car and truck design and the designer's preference.

If the brake is a duplex brake, that is, having a service ratio and an emergency ratio, then the size and strength of the foundation brake gear must be based upon the maximum total cylinder pressure.

It will be seen that not one of these eight values can be included among what we have called the fundamental requirements and further, and even more important, not one of them can be arbitrarily chosen, but must follow in the same manner that four follows the adding of two and two, if we are to have a harmonious and consistent brake, and to avoid this being dismissed with the assertion that the ideal is not attainable, I will state that by harmonious and consistent, I mean a practical brake.

It will be understood that after going into this matter in detail, the conditions affecting brake operation were taken up and the electric operation of triple valves, control valves and universal valves was touched upon, as well as the calculated and actual performance of modern brake equipments and in connection with the latter examples and formulas for making these calculations are given, the features of electrical control of the brake is dealt with in a comprehensive manner and the conclusions of Mr. Turner on this subject follow:

No doubt some of you may conclude that, as presented, the brake problem is a very intricate and complex one. In fact, you may even say that you may have expected me to simplify the problem as it already existed in your minds, instead of which it is more of a problem than ever I ask you to remember that I am not responsible in any manner for the problem. Nature is responsible for the existing forces, or rather nature prefers to remain in a state of equilibrium, but when men in the form or shape of railroads undertake to disturb this equilibrium by starting great weights into motion, it is imperative that these same men adopt means for controlling or dissipating the energy thus developed, otherwise that which they are endeavoring to accomplish can at the best only be attended with many calamities. Again unless means are provided for controlling this energy or bringing the mass back to a state of equilibrium again, the capacity of the railroad, both in mileage and equipment, will be very much curtailed, since, if a speed of 60 miles per hour were permitted, trains could not be run closer than five miles apart, as shown by the chart, and the average speed could not be more than 30 miles per hour where stopping places were not more than 8 miles apart. In other words, it would not be considered safe to have more than one train for every 8 miles. Contrast this with the condition where a first-class brake is employed, that is, where the energy at 60 M. P. H. can be dissipated in 1,000 feet Here the average speed could be 48 M. P. H., an increase of over 50 per cent., and considering the distance over which the train would be retarding in the previous case, the average speed would be over 59¾ M. P. H., as against 30—an increase of practically 100 per cent., and as far as the number of trains is concerned, trains could be run 1,000 feet apart with the same degree of safety as 5 miles apart in the first case, while three times as many trains could be on the same piece of track in an equal time with even a larger margin of safety, and, of course, what is said here, which may be applied to passenger trains, is equally true with regard to freight trains. That is to say, means must be provided for controlling them or dissipating their energy at will if safe operation is to be assured on the one hand, and a reasonable and commercial capacity of the road developed on the other.

This shows then that the brake has nothing whatever to do with the creation of the problem, and, consequently, can have nothing to do with its intricacies and complexities—the problem is as it is, and has been created by the endeavor of progressive and exceptional men to get the most out of nature's forces and possibilities for the welfare and progress of man. This being the case, the man who either thinks or endeavors to set up the problem as a simple one, is not the man who is rendering the desired, in fact necessary, assistance, to those who have created the necessity for a brake. A man who comprehends that it is a complex and real problem and therefore sets himself up to understand the principles underlying it and the requirements, is the man from whom the most may be expected, and he will render as much service to the railroad as does the man whose ingenuity and labor has created the necessity for a brake. To this end, he should fully realize that the brake must be considered as a whole, and here I do not mean merely as the complete equipment on a car from brake pipe to wheels inclusive, but the brake as a whole counting from the locomotive to the last car in the train, as it is the whole combination that determines what the action and operation of the brake shall be. If there is one factor in the brake that is relatively fixed, it is the air operated mechanism itself—all the rest that goes to make it up is extremely variable, even at best, but when not considered as a part of the whole, and therefore not kept as closely constant as may be, the resultant operation may be and often is far from what is desired.

No doubt it will sooner or later be appreciated that the problem of controlling trains, taken in its entirety, involving a consideration of the rail adhesion, all the various truck and car designs, weights of cars, empty and loaded, speeds and frequency of trains, service and emergency operations of the brake, the elements of both the automatic and human equation which enter into brake performance, as well as all other factors involved, in smoothly controlling a train on the one hand and quickly stopping it on the other, is one of considerable magnitude, taxing both the ability and ingenuity of a thoroughly informed, specialized mechanical engineer, and from this no doubt the Superintendent of the Motive Power will be provided with an assistant whose duties it shall be to secure such a harmony of design and equipment and such assurance for manipulation and operation as this paper points out, as must be the case, if full and profitable results of the air brake are to be obtained.

If I have succeeded in making clear to you the great advantage accruing from actuating the pneumatic brake electrically; if I have impressed you a little more deeply than perhaps some of you have heretofore realized, that there are many things beside the operating devices themselves that play an important part in the operation of the brake; if I have made clear that co-operation, that is, team work, by all concerned, to the end that all parts and conditions affecting the operation of the brake should receive due care and consideration, and that the returns make it worth while, I shall feel that my efforts to serve you have not been in vain.

During the discussion of this paper, Mr. D. R. MacBain, Superintendent of motive power, L. S. & M. S. R. R., spoke on the brake problem in a very broad and comprehensive manner relating some difficulties experienced on the road with which he is connected, and said:

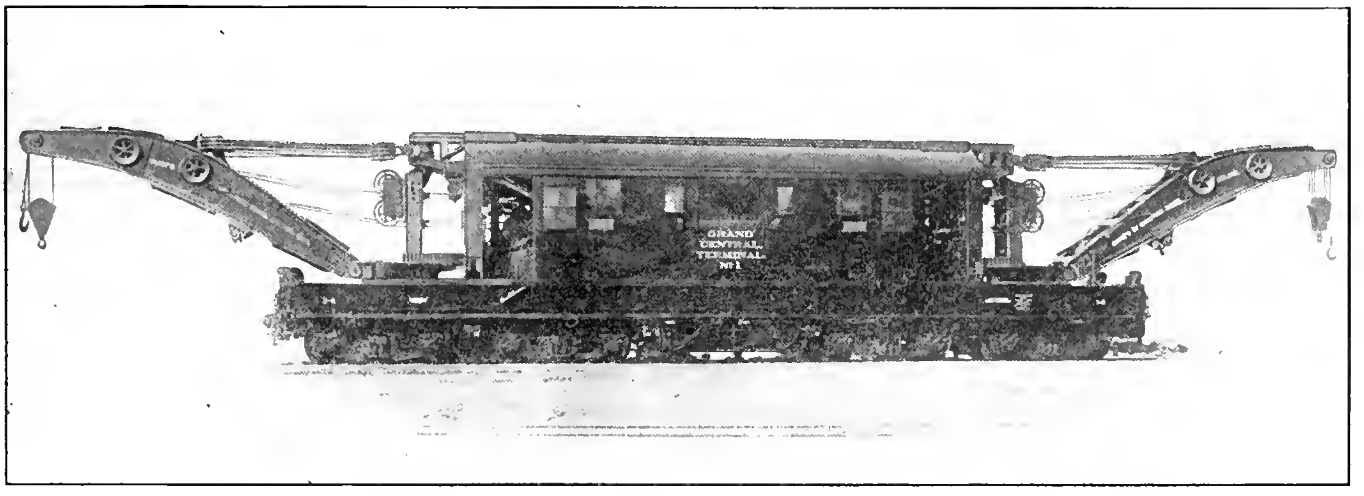
"In conclusion, I wish to say, Mr. President, as I said before, that I believe that this is the best air brake paper that was ever read in the United States—and I have read all of them. I began away back at the time when we were operating passenger trains with straight air 'and followed the thing through to the present time, and I want to say that Mr. Turner's paper is the best and most lucid that was ever delivered to the railroad public."

"Every man should make up his mind that if he expects to succeed, he must give an honest return for the other man's dollar. Grasp an idea and work it out to a successful conclusion. That's about all there is in life for any of us."—*Edward H. Harriman.*

Electrical Department

100 Ton Tunnel Crane.

A noteworthy piece of equipment for use in case of accidents or wrecks within the electric division of the New York Central R. R. has been received recently in New York. This appliance is a double end electric wrecking crane, with independent 100 ton capacity cranes at each end, the whole being especially designed for the underground clearances and conditions existing in Grand Central Terminal. It is also adapted for use on the main line of the electric division, where operating conditions and clearances are such as usually obtained on steam roads. It combines the functions of a crane with many of those of a high power electric locomotive. It is completely equipped for high speed, independent operation, with air brakes, whistle, and all necessary fittings.



100-TON TUNNEL CRANE FOR THE NEW YORK CENTRAL RAILROAD.

In construction the crane is unusually massive and of great strength. The car body is 67 feet long, with a wheel base of 51 feet, and is carried on two compound trucks, made up of two four-wheel trucks each. A cradle on which the car body rests allows the compound trucks, as well as each single truck, to have perfect freedom to swing when taking curves. Complete air brakes are provided, also a hand brake wheel at each end. There is a comprehensive system of air-operated telescopic outriggers or jack beams, used to add stability during heavy lifting, and to distribute the load over a greater area. These are controlled by valves with suitable levers, and are instantaneous in action, thus combining ease and speed of operation.

The electrical equipment is noteworthy, not only on account of the power it develops, but because of its flexibility. Six principal motors with a total of 1,100 h. p., are used for operating the crane, as follows: Four of 200 h. p. each for propelling, and two of 150 h. p. each for hoisting and for operating the machinery.

For intermittent and emergency service, as might be required with the third rail out of commission, or when suitable cable connections could not be made with a feed line, there is installed on the crane a high capacity U-S-L storage battery. This is ready for instant service to operate the crane independently of any outside source of power. It consists of 230 cells of the pasted plate type connected in series, 25 plates per cell, and has a capacity of 75 amperes for 8 hours, with a maximum discharge rate of 350 amperes for two hours. The cells are the standard U-S-L car lighting battery type, and are connected with extra heavy cable because of the high amperage the battery will at times be forced to deliver. There is a complete testing and charging outfit, in order that the battery may be charged anywhere that connection can be made with a feed line.

This crane was designed and built by the Industrial Works, Bay City, Mich., from specifications prepared by a committee consisting of H. A. Currie, assistant electrical engineer; B. S. Buell, wrecking master, and C. H. Quereau, superintendent electrical equipment of the New York Central & Hudson River Railroad.

Vacuum Tube Lighting Arresters for Railway Signal Circuits.

Everyone knows that it is very important to provide lightning protection for railway signals, as it is very necessary for prompt dispatching of trains to have continuous operation of signals.

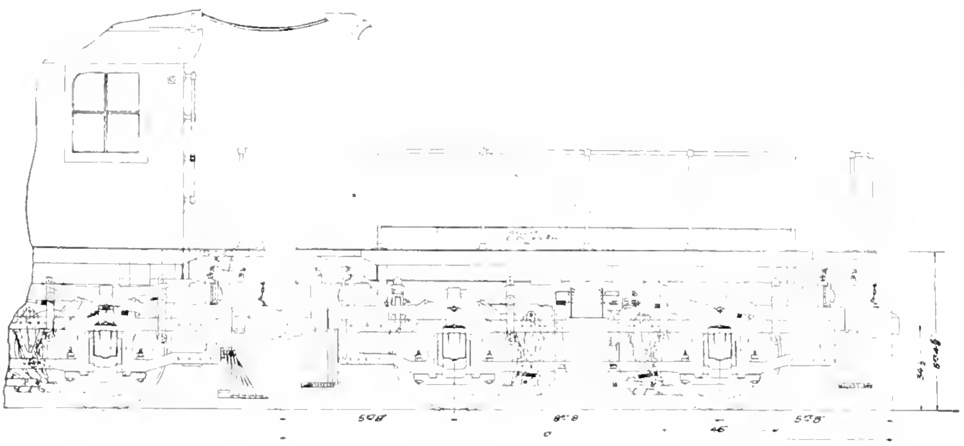
Two vital requirements of the lightning arrester used in connection with signals are, *first*, a low spark potential so that discharges will occur at low rises in voltage, and second, freedom from a short circuit through the arrester, following a lightning discharge. The first calls for a small gap, the second a large one. Both conditions are met by using a large gap in a vacuum. The large gap will prevent the short circuit, while the vacuum reduces the spark potential, i. e., the same voltage will jump a much greater distance in a vacuum than in air.

The General Electric Company have built an arrester of this type. The general construction is as follows: The main body is a drawn metal shell, with a metal disc smaller in diameter than the inside diameter of the tube mounted concentric. The tube is one terminal, and the disc the other, so that there is an air gap completely around the disc. The disc is mounted on a rod, which serves as the electrical connection to the disc, and is insulated from the tube by means of a special moulded bushing. The bushing does not form the vacuum, a compound which is poured in and hardens is used for that purpose. The tube is exhausted and then sealed.

Tractor Trucks and Additional Locomotives for the Butte, Anaconda & Pacific 2400 Volt Railway.

For the past year there has been in operation on the above railway seventeen 80-ton electric locomotives. Recently

four additional ones have been ordered. In order to make these locomotives suitable for very slow speed spotting service a tractor truck, shown in the illustration, can be used in combination with the electric locomotives. These trucks are an ingenious adaptation of standard parts of the freight locomotives; by their use the tractive effort of the standard locomotive is increased 50 per cent. at two-thirds speed without increase in power consumption. These units will be used especially for spotting cars at the smelter, and also for low speed switching in the Butte yards.



TRACTOR TRUCK.

During the present year it is expected that approximately 25 per cent. more ore will be transported from Butte to Anaconda than was hauled last year. This increase arises from the transfer of ore which was previously hauled to smelters at Great Falls. The additional haulage will bring the total annual traffic on the road up to about six and one-quarter million tons.

The tractor trucks, equipped with two motors of the same type as the locomotive, are each provided with cable and connecting plugs, so that the two motors can be operated with the other motors from the same controller.

The arrangement of the six motors are as follows: First the six motors will be connected in series, and then with two sets in multiple, each set consisting of three motors.

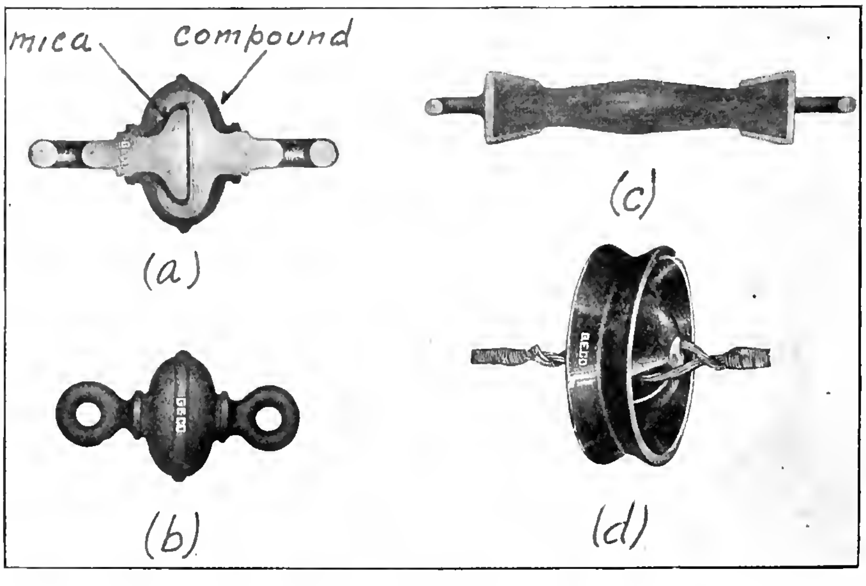
Mechanically these trucks are similar in construction to the trucks on the 80-ton locomotives. Instead of a locomotive body, however, a platform is supplied, built up of channels, angles and plates which are supported on the truck transom. Struts are provided at the corners to secure the platform to the side frame. Ballast consisting of cement and iron punchings of sufficient quantity to bring up the weight of the truck to 40 tons is placed between the center channels of the platform in a box-like structure built for this purpose. A passageway protected by a hand rail extends along each side of the platform.

In the center of the platform is a crane extending at an angle, and which is provided as a support for the eight cables running between the truck and the locomotive. This crane can be revolved 180 degs. so as to permit the coupling of the locomotive to either end of the truck.

Strain Insulators.

Strain insulators, of which there are several types, are used very extensively wherever electric circuits are installed. It is necessary to support and guy these electric circuits so that insulators are necessary in these supporting and guy wires to prevent the grounding of the electric power. These wires are under tension, and the insulators must be so constructed that they will withstand mechanically the strains, hence the name strain insulators.

The three most common types are the giant strain, the wood strain and the porcelain strain. The giant strain insulators are for use on low voltage power and telephone circuits, the wood strain insulators are used on lighting circuits and in secondary guying, and porcelain strain insulators are used on high tension lines. By high tension we mean high voltage.



STRAIN INSULATORS.

GIANT STRAIN INSULATORS.

This insulator is shown by (a) and (b) in the illustration. It is composed of malleable iron castings which have been previously sherardized. One of these castings is in the shape of a cup, and the other is stud shaped. Before assembly the sides of the cupped shaped casting are nearly parallel so that the stud will fit inside of the cup. When assembling sheets of amber mica are placed between the stud and cup, and the two castings are then crimped together at a pressure of 40 tons, which makes an absolutely fast joint not affected by temperature changes. The strength of the insulator is limited only by the strength of the eyes or clevises. The mica used is the highest and most durable insulation available. Without some protection on the outside of the two castings the electric current could easily creep between them and the line would became grounded. To prevent this creepage a tough, non-absorbent, heat-resisting compound is moulded about the joint. The exterior surface is so formed as to prevent the formation of a continuous film of moisture between the metal parts.

These insulator are generally made in two sizes: 2 inches and $2\frac{5}{8}$ inches in diameter. The 2 in. size can be used for working loads up to 1,000 lbs., and the $2\frac{5}{8}$ in. size up to 2,500 lbs.

WOOD STRAIN INSULATORS.

This type (C) has an important advantage over other types in that the length of the wooden body between caps provides a long creepage surface, and that the insulating value is many times greater than required for the voltages with which they are used.

The bodies are turned from hickory billets well seasoned and kiln dried. After they are turned, the sticks are impregnated with oil which is the subsequent treatment becomes oxidized, closing up

the pores of the wood. A coat of transparent varnish is applied after finishing.

In specifying sizes of wood strains the minimum diameter is taken. The standard diameters are 1 in., 1¼ ins. and 1¾ ins., and are suitable for working loads of 1,000 lbs., 2,500 lbs. and 5,000 lbs. respectively. The length varies with the voltage, the usual sizes being 5 ins., 10 ins., 15 ins., 24 ins. and 48 ins. This dimension is between the metal end caps.

PORCELAIN STRAIN INSULATORS.

The strain insulators used with high voltages must possess high mechanical and electrical features. The general form is shown by (d). The holes are so cored in the porcelain that they are interlinked, and the mechanical stress between the two guy wires is in compression. Porcelain has a poor tensile strength, but a very high compression strength. The shape of the insulator is such that it is impossible for rain driving in any direction to maintain a continuous film of moisture between terminals.

Another Gas-Electric Car for the Electric Short Line Rwy. Co., Minneapolis.

The above railway company has recently ordered its fifth gas electric car from the General Electric Company. This car is of the same type as has been fully described in a previous issue. It measures 70 ft. over bumpers, is 10 ft. 6⅜ ins. wide over-all, and weighs approximately 50 tons. The car is divided into four compartments: 1st cab, which measures 11 ft., containing the power plant; 2nd, the baggage room, 11 ft. in length; 3rd, the smoking compartment, 12 ft. 5 ins. long, and 4th, the passenger compartment, 30 ft. 6 ins. long. Seats are provided for 91 passengers.

Armature Winding on Railway Motors.

R. L. C., of Ceres, California: Direct current motors and electric locomotives and cars having four poles in most all cases have the brushes 90 degs. apart on the commutator, and only two brushes. What wiring arrangement allows for this; why shouldn't there be four brushes?

ANSWER.—Railway motor armatures are wound with what is known as a wave winding. All the coils are so joined at the commutator bars that they are all connected together, and form one continuous winding which closes on itself. This type of winding makes it possible to use only two sets of brushes, and at the same time get full power from the motor. The electric current entering the positive brush divides itself, part passing one way around the armature to the negative brush, and part the opposite way so that every coil is in use. The addition of two more sets of brushes would not be of any advantage; in fact would be of a disadvantage in the railway motor, for two of the brush holders would be located at the bottom half of the motor shell, at which location they are very hard to inspect. Moreover, these lower brushholders would be subjected to dirt and many times water, so that the operation of the motor would not be as satisfactory. With only two sets of brushes each set must carry the whole current, whereas if four are used each set would only carry one-half of the total current. This is easily taken care of by making the length of the commutator and the size of each set of brushes sufficient to handle the currents which will be taken by the motor.

TWO-UNIT FREIGHT LOCOMOTIVE HAULING 65 CARS. BUTTE, ANACONDA & PACIFIC RAILWAY.

A Novel Electric Locomotive.

When speaking of a locomotive, one immediately pictures a machine pulling or pushing cars on the same track with itself. This is usually the case, but recently the Pennsylvania Lines West had three locomotives built for handling cars at their Cleveland ore docks. These locomotives do not run on the standard gauge tracks, but on a 42 inch track parallel to them. They are equipped with an arm on each side, and push the cars along. With this arrangement cars can be easily shifted and cut out of trains.

Steel Passenger Cars.

On January 1, 1914—the latest date for which statistics are available—the Pennsylvania Railroad System, with 2,554 all-steel passenger cars in service and 379 others under construction, owned more than one-third of all the steel passenger equipment cars in use in the United States.

The above figures are exclusive of sleeping and parlor cars. The total number of all-steel passenger cars, other than Pullman cars, in service in the United States on January 1, 1914, was 7,377. To replace with steel all-wooden passenger cars now in use in the United States will cost about $581,000,000.

There were 2,115 steel sleeping and parlor cars in service on all roads on January 1, 1914, and 750—more than one-third—of this number were in use on the lines of the Pennsylvania System. Every sleeping car normally in use on the Pennsylvania System is of all-steel construction.

The Pennsylvania Railroad announced in 1906 that all future additions to its passenger equipment—passenger coaches, postal cars, baggage cars, express cars, etc.—would be of all-steel construction, and on January 1, 1914, almost exactly one-half of its passenger equipment had been replaced with steel cars. The Pennsylvania had 6,100 passenger equipment cars in service on January 1, 1914.

Things That Appear Equal to One Another and Are Different.

Many railway men think it strange that the journal of a car axle will not endure the pressure put upon a locomotive crank pin without becoming hot. An "anxious engineer" assails us with this question: "Why is it that the Master Car Builders and other railroad organizations insist that the car bearings shall not have working pressure put upon them to exceed 300 pounds per square inch? You know that this limited requirement as to weight is all nonsense, for the crank pin of a locomotive stands five or six times that pressure without showing any tendency to become hot. My impression is that inferior lubrication is the cause of car journal's heating, as compared with crank pins. If the same quality of lubricant used for crank pins was used for car journal bearings there is no reason for believing that they would not bear the same pressure without getting hot. Things that are equal to the same thing are equal to one another."

We are glad to give this question attention because it reflects a fallacy held by many railway men. The effect of pressure upon a car journal and that upon a crank pin are not the same, although the pressure may be equal, or much greater in the case of the crank pin. The crank pin will run cool under much greater pressure than that put upon a car journal because of the relaxing of pressure on the brass of the pins at every change in the piston motion, which permits oil to enter between the brass and the pin keeping, the latter in a bath of oil all the time. Things that are equal to the same thing are equal to one another if it is really the same thing they are equal to.

General Foremen's Department

Tenth Annual Convention of the International Railway General Foremen's Association.

From all indications the next convention of the International Railway General Foremen's Association will lead all other conventions held by this association in point of attendance. Advance copies of papers to be submitted to the meeting which will be held at the Sherman House, Chicago, Ill., July 14 to 18, have been sent out 30 days in advance and are now in the hands of the members.

Copies of the papers are sent to the members so they have an opportunity of studying them, and then come to the meetings fully loaded ready to acquiesce with, or to dissent from the views expressed. It is earnestly desired that all concerned read these papers over very carefully, and fortify themselves, so that if called upon they will be ready to give their views upon each or all of the topics. It is expected that a new departure will be made at this convention, in that the topics will be announced from the chair, and the members will proceed at once with the discussion, thus dispensing with the lost motion of reading the paper through first. This is lost time, for unless the papers have been read before the time of taking them up, they cannot be discussed intelligently from the usual way of reading them. If the experiment proves to be non-successful, the old plan will be resorted to again.

Several other new features will be introduced, but with what success remains to be seen.

The aim of the association is for a greater efficiency among its members, ergo, we must not get into a rut, and if each member will do his part the burden placed upon the shoulders of the officers will be lightened very materially.

The individual papers are in the hands of some of the ablest members of the association and the discussions following the reading of these papers will bring out the highest efficiency in shop and roundhouse practices that will have a tendency to reduce engine failures and a reduction of shop and engine house expense which in these times of strictest economy in railroad operation will be gladly accepted by railway officials as standard practices.

"Engine House Efficiency," a continuation of paper read at the 1913 convention, will be handled by Walter Smith. It is a high-class article and goes into the details of this most interesting subject.

J. T. Mullin will bring out up-to-date methods of handling cylinders, pistons, crossheads, guides and valves.

C. W. Newman has a most instructive paper on the practices and methods of maintenance and repairs to the air brake.

C. L. Dickert will bring out the first paper ever read at a general foremen's convention relative to autogenous welding and its advantages.

J. W. Scott's paper "Railroading at a High Altitude" should prove interesting, as Mr. Scott is located at La Paz, Bolivia, and is thoroughly acquainted with the conditions in that territory.

The Taylor System, the Principles of Scientific Management, will be a subject new to the Association and will be presented by Mr. W. W. Scott, an able exponent of the system.

The above subjects together with the wonderful display of mechanical ingenuity which will be on exhibition during the sessions in the display parlors of the Sherman House makes a combination hard for general foremen to resist. Railroad officials looking for higher efficiency will insist upon their road being represented at the convention.

Standard Sizes for Locomotive Repairs.

The modern plan of building locomotives and other machinery on the interchangeable system renders it a comparatively easy matter to maintain standard lengths and sizes in making repairs in the roundhouse and machine shop.

In the olden time, when no two engines were alike, even from the same builder, and when contracts were given to several different firms for locomotives, there was some excuse for an irregular system, or no system, in making repairs, but those days are gone, and roads now, or at least new roads are equipped with engines from one builder.

It is a bad practice to alter the length of a spring hanger in order to equalize an engine. The spring is at fault, and not the hanger. The spring is changeable, its "set" is sometimes more, sometimes less. The hanger is rigid and does not change. Make up for the weakness of the spring by putting liners, or "Dutchmen," under the gib in hanger, and when you get a spring that has full set, take liners out. When hangers are repaired, bring them back to the original length. Find out from a new engine what that length should be, and make a drawing or templet of the same, and keep it as a standard for the men to work by. If this plan were adopted it would save a vast amount of "cutting and trying." As an example, suppose that an engine has one weak spring. The foreman or machinist gives it a squint, and reasons, very properly, that if those two hangers were shortened just a little, or that spring saddle lengthened a trifle, she would sit all right; suiting the action to the word, the work is done. After a few trips that particular spring breaks and a new one must take its place. What is the result? Another man puts it in, he sees that something is wrong; just what, he does not know, but one thing is quite evident, that spring gear is all out of whack, and so tinkers at this or that hanger, puts a different shape to equalizer, saddle, or something, he don't care much what—anything, so as to make her set level.

The standard set of each spring should be known, and the spring compared with that standard before being put in, and, if weak, pick out the liners to make it up to "correct pitch" before you put it in. It will save lots of packing and sweat this hot weather.

After a few years, if a haphazard style of repairing is carried on, there will be no standards, and it will be impossible, without a great amount of study, to tell what the original size was.

The same may be said of the other parts of a locomotive, set screws, nuts, keys, etc. Keep them to standard. By so doing a supply can be kept on hand, and not a great variety, either, always ready for an emergency and sure of fit. 'Twill save many extra jobs at night and on Sunday. The expense of keeping up engines will be greatly reduced and their life prolonged.

It will save much wear and tear on the foreman. Every repair shop on the road should be furnished from the general shop with a complete set of blue prints of all parts of the engines, or at least of those pieces that will have to be repaired. From these prints patterns or templets can be made for the use of blacksmith or machinist. Jigs can be made for drilling holes, so that the labor of laying out can in a large measure be done away with.

See that the men are thoroughly informed on these points. The foreman's labor should be to think them out, and instruct the men in their use, and see that they are taken care of and kept to standard.

Seventy-Ton Self-Clearing Coal Car of the Standard Car Truck Co.

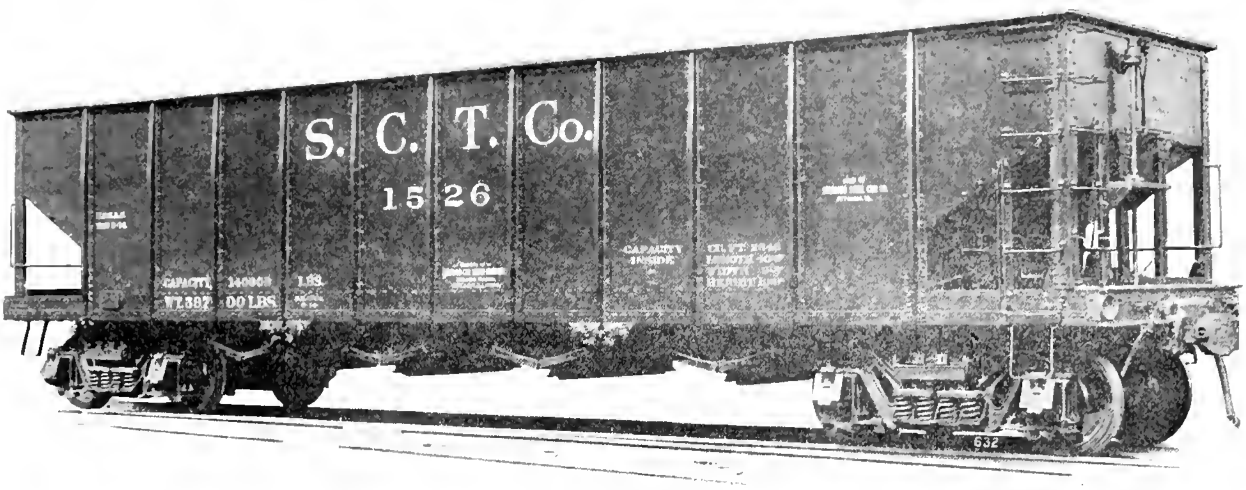
The illustration shows one of the eleven 70-ton self clearing coal cars recently built by the Standard Steel Car Company for the Standard Car Truck Company. Ten of these cars are assigned to the Erie Railroad. The main feature of the car is the four point bearing double action truck. This style of truck has been thoroughly tested under several flat and ore cars during the past six years. The car body and load is supported at the center line of the truck side frame by a special radial roller device which works in harmony with the well known Barber lateral motion roller device now in general use on a large number of freight cars and locomotive tenders in the United States and Canada. The cast steel truck side frames are a special I-beam drop girder type. The truck springs are the M. C. B. standard for 35-ton arranged in four groups of two, for each frame; two groups on the outside of the web of the frame and two on the inside; all equalized into proper bearing by spring taps and a spanning roller seat. The truck bolster is a 24-in. rolled steel I-beam placed horizontally and serves only in taking switching shocks and carrying the center pivot castings. The angle cross ties of the truck extend through openings in the side frame and are riveted on both sides of the web to the flange of the frame.

The journals are 6 in. by 11 in. The wheels applied are of three different makes, for comparative wearing test; two of forged steel and one of cast steel. The journal boxes are arranged with shims for raising car when wheels are turned. Brake beams are supported by removable brackets attached to side frames. The two sides of the car body form girders which carry the entire load, there being no intermediate or center sills. The body bolster and end sills form the cords of a wide girder which receives the draft attachments. The cast steel pedestals which are attached near the ends of the body bolsters are fitted to and interlock with the crown face of the radial roller cap.

The car is 42 ft. 9½ in. over buffer castings; 10 ft. extreme width; 10 ft. 6¾ in. extreme height; 9 ft. 3 in. inside width; cubic capacity, 2,646 ft.

The car is equipped with the following specialties: Enterprise Railway Equipment Company's dumping mechanism, Miner friction draft gear No. A-18, Simplex couplers, Blackall ratchet hand brake, McCord journal boxes, New York air brake, Creco brake beams, Bronze Metal Company's journal bearings, Carmer "pull-up" type uncoupling device.

One of these cars will be on the exhibit track at the M. M. and M. C. B. convention at Atlantic City, June 10-17.



SEVENTY-TON SELF-CLEARING COAL CAR OF THE STANDARD CAR TRUCK COMPANY.

Rail Statistics in the United States.

Statistics have been compiled by the Bureau of Statistics of the American Iron and Steel Institute, showing the production of rails in the United States during 1913 and comparing this production with that of foregoing years.

In 1913 there were produced 3,502,780 tons of rails of all kinds, against 3,327,915 tons in 1912, an increase of 174,865, or 5.2 per cent. Included in the total for 1913 are 195,659 tons of girder and high T-rails for electric railways, against 174,004 tons in 1912 and 205,409 tons in 1911.

The most significant feature of the bureau's report is the comparison of manufacture of Bessemer and open-hearth steel rails. In 1906, when the maximum rail production was reached, the production of Bessemer steel rails amounted to 3,791,429 tons, while in 1913 the production had decreased to 817,591. During the same period the production of open-hearth steel rails had increased from 186,413 tons in 1906 to 2,527,710 tons in 1913, which is an increase over 1912 of 422,566 tons, or 20 per cent. Of the total production in 1913 about 72.16 per cent. was rolled from open-hearth steel, about 23.34 per cent. from Bessemer steel and about 4.50 per cent. from electric steel, old steel rails and renewed rails.

In 1913 nearly 29.9 per cent. of the rails weighing less than 50 lbs. per yard, nearly 48.7 per cent. of the rails weighing 50 lbs. and less than 85 lbs., and over 87.2 per cent. of the rails weighing 85 lbs. and over were rolled from open-hearth steel, while in the same year nearly 41 per cent. of the rails weighing less than 50 lbs. per yard, over 44.8 per cent. of the rails weighing 50 lbs. and less than 85 lbs., and nearly 12.1 per cent. of the rails weighing 85 lbs. and over were rolled from Bessemer steel. In addition, in 1913, over 29.1 per cent. of the rails weighing less than 50 lbs. per yard, over 6.5 per cent. of the rails weighing 50 lbs. and less than 85 lbs., and less than 1 per cent. of the rails weighing 85 lbs. and over were rolled from electric ingots and old steel rails or were renewed rails.

Locomotive Engineers Convention in Halifax.

A great union meeting of the Brotherhood of Locomotive Engineers will be held at Halifax, N. F., beginning July 20, lasting five days. The convention is called for business purposes, but attractive social functions will increase the attractions. The Ladies' Auxiliary will be much in evidence, their influence calling for clam bakes, dances and other ways that men and their kind are moved to flee from dull care.

Items of Personal Interest

Mr. J. J. Shaw has been appointed master mechanic on the St. Louis & San Francisco.

Mr. E. A. May has been appointed car inspector of the Hilo railroad, with office at Hawaii, H. I.

Mr. P. M. Gault has been appointed signal inspector on the Illinois Central, with office at Chicago, Ill.

Mr. M. Afflague has been appointed master mechanic of the Hilo railroad, with office at Hawaii, H. I.

Mr. J. J. Carey has been appointed master mechanic on the Texas & Pacific, with office at Marshall, Tex.

Mr. F. C. Stuart has been appointed signal engineer on the Elgin, Joliet & Eastern, with office at Joliet, Ill.

Mr. S. Robinson has been appointed general car foreman on the Pere Marquette, with office at Toledo, Ohio.

Mr. George Burn has been appointed general foreman on the St. Louis & San Francisco, with office at Enid, Okla.

Mr. L. W. Meek has been appointed signal supervisor on the Texas & New Orleans, with office at Houston, Tex.

Mr. H. Shoemaker has been appointed mecahnical superintendent of the Bangor & Aroostook, with office at Derby, Me.

Mr. C. A. Brackett has been appointed general foreman car repairs on the Vandalia, with office at Terre Haute, Ind.

Mr. C. E. Oakes has been appointed mechanical engineer on the Kansas City Southern, with office at Pittsburgh, Pa.

Mr. V. A. Wood has been appointed general foreman on the Chicago, Burlington & Quincy, with office at Lincoln, Neb

Mr. P. H. Maley has been appointed roundhouse foreman on the Minneapolis & St. Louis, with office at Oskaloosa, Ia.

Mr. H. P. Roby, traveling engineer on the Bangor & Aroostook, has been transferred from Milo Junction to Derby, Me.

Mr. Ernest Baxter has been appointed Purchasing Agent of the St. Louis, Southwestern. Headquarters, St. Louis, Mo.

Mr. W. H. Owens, master mechanic on the Southern, has been transferred from Manchester, Va., to South Richmond, Va.

Mr. John Feld has been appointed foreman of boiler shop on the Minneapolis & St. Louis, with office at Marshalltown, Ia.

Mr. F. Drolet, general engine foreman on the Bangor & Aroostook, has been transferred from Milo Junction to Derby, Me.

Mr. A. R. Dale has been appointed general storekeeper on the Florida East coast railway, with office at St. Augustine, Fla.

Mr. John Johns has been appointed master carpenter on the Baltimore & Ohio, with office at St. George, L. I., N. Y.

Mr. P. Smith has been appointed road foreman of equipment on the Chicago, Rock Island & Pacific, with office at Chicago, Ill.

Mr. J. J. Robinson, general foreman on the Southern, has been transferred from Manchester, Va., to South Richmond, Va.

Mr. H. Allen has been appointed general car foreman of the Galveston, Harrisburg & San Antonio, with office at El Paso, Tex.

Mr. G. H. Fragine has been appointed master carpenter on the Lake Shore & Michigan Southern, with office at Cleveland, Ohio.

Mr. L. R. Pyle has been appointed fuel inspector on the Minneapolis, St. Paul & Sault Ste. Marie, with office at Minneapolis, Minn.

Mr. H. A. Martin, general car foreman on the Bangor & Aroostook, has been transferred from Milo Junction, Me., to Derby, Me.

Mr. H. C. McClanahan has been appointed division superintendent of the Mexico North-Western, with office at Pearson, Mex.

Mr. N. Thibideau has been appointed mechanical superintendent of the Caraquet & Gulf Shore railway, with office at Bathurst, N. B.

Mr. H. C. Dean has been appointed assistant locomotive superintendent of the St. Louis & San Francisco, with office at Sapulpa, Okla.

Mr. B. Kimball has been appointed general foreman, locomotive department of the San Antonio, Uvalde & Golf, at Pleasanton, Tex.

Mr. C. H. Motsett has been appointed general superintendent and chief engineer of the Panama railroad, with offices at Colon, Panama.

Mr. A. A. Harris has been appointed master mechanic of the New York, New Haven & Hartford, with offices at East Hartford, Conn.

Mr. George Terry has been appointed active roundhouse foreman on the Intercolonial railway of Canada, with office at Moncton, Canada.

Colonel Harlow D. Savage, general Eastern sales manager, American Arch Company, has been elected vice-president of that company.

Mr. F. O. Walsh has been appointed superintendent of motive power and equipment on the Georgia railroad, with offices at Augusta, Ga.

Mr. N. T. Davidson, foreman on the car department on the Southern at Manchester, Va., has been transferred to South Richmond, Va.

Mr. F. M. McNulty has been appointed superintendent of motive power of the Monongahela Connecting railroad, with office at Pittsburgh, Pa.

Mr. F. E. Ballda has been appointed superintendent of shops of the New York, New Haven & Hartford, with office at New Haven, Conn.

Mr. H. E. Dyke, general foreman on the Cincinnati, New Orleans & Texas Pacific, has been transferred from Danville, Ky., to Oakland, Tenn.

Mr. J. C. Gribben, general foreman on the Cincinnati, New Orleans & Texas Pacific has been transferred from Oakland, Tenn., to Danville, Ky.

Mr. J. J. Heyburn, assistant locomotive superintendent on the St. Louis & San Francisco, has been transferred from Sapulpa, Okla., to Ft. Smith, Ark.

Mr. E. T. Brake has been appointed general foreman of the locomotive department on the Chicago, Milwaukee & St. Paul, with office at Milwaukee, Wis.

Mr. W. H. Maline, assistant superintendent of locomotives on the St. Louis & San Francisco, has been transferred from Fort Scott, Kan., to Springfield, Mo.

Mr. W. H. Davis has been appointed master mechanic of the Marshall & East Texas, with office at Marshall, Tex., in place of Mr. C. E. Langton, resigned.

Mr. S. R. Richards, superintendent of shops on the New York, New Haven & Hartford, has been transferred from New Haven, Conn., to Readville, Mass.

Mr. W. T. Kuhn, formerly master mechanic on the Toronto, Hamilton & Buffalo, has been appointed superintendent of motive power, with offices at Hamilton, Ont.

Mr. C. O. Destiche has been appointed superintendent of motive power of the South Dakota Central, with offices at Sioux Falls, S. D., in place of Mr. H. J. Osborne, who has resigned.

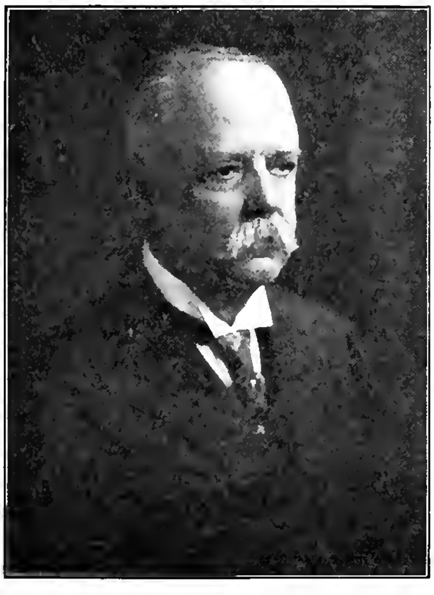
Due to the increased activities of the railway and lighting department of the Westinghouse Electric & Manufacturing Company in connection with the work of railroad electrification and heavy power house apparatus, the management has created the positions of assistant managers of this department. Messrs. E. P. Dillon and M. B. Lambert have been appointed to these positions.

Mr. Dillon will have charge of the commercial activities of the company in connection with the generation and distribution of power, involving power house, sub-stations, transformer stations and similar apparatus.

Mr. Lambert will have charge of all sales work pertaining to electric traction, including steam, interurban and city railway propositions.

Both Mr. Dillon and Mr. Lambert have been connected with the railway and lighting department of the Westinghouse company for a number of years and are widely known in the electrical profession.

Mr. Theodore Voorhees has been elected President of the Philadelphia & Reading. Mr. Voorhees has had an interesting and wide career as a railway man. Graduating from the Rensselaer Polytechnic Institute of Troy, N. Y., he entered railway service in 1869, since when he has been consecutively from 1869 to 1874 on the Delaware, Lackawanna & Western; four years in the engineering department; two years superintendent on the Syracuse, Binghamton & New York. From 1874 to 1875, in the transportation department of the Delaware & Hudson Canal Company at Albany, and from 1875 to 1885 superintendent of the Saratoga and Champlain divisions of the Northern road department of the Delaware & Hudson. From 1885 to 1890, assistant general superintendent New York Central & Hudson River road, and from 1890 to 1893, general superintendent of the same road, also general superintendent Rome, Watertown & Ogdensburg, and from 1893 till the period of his present appointment he was vice-president of the Philadelphia & Reading road. Mr. Voorhees is still in the vigor of his strong manhood and much excellent work may still be expected from him.



THEODORE VOORHEES.

Mr. Elisha Lee has been appointed general superintendent of the Philadelphia, Baltimore & Washington, with offices at Wilmington, Del. Mr. Lee is a graduate of the Massachusetts Institute of Technology, from which he graduated in 1892. He entered railway service in 1892 as roadman in the office of the division engineer of the Tyrone division of the Pennsylvania, since which he has been consecutively assistant supervisor and supervisor during a period extending to 1903. From 1903 to 1907 he was assistant engineer of maintenance of way, and from 1907 to 1909 principal assistant engineer of the Philadelphia, Baltimore & Washington division of the same road. From 1909 to 1911 he was superintendent of the New York, Philadelphia & Norfolk, and early in 1911 he was assistant to the general manager of the Pennsylvania lines east of Pittsburgh, Pa. It will be remembered that Mr. Lee acted as chief council for the Eastern roads before the arbitration board in the recent conference in regard to the increase of the wages for firemen. Mr. Lee's fair methods and gentlemanly courtesy won him the esteem and respect of all with whom he came in contact.

ELISHA LEE.

Mr. James J. Turner has been elected President of the Monongahela railroad, with offices at Pittsburgh, Pa. Mr. Turner has had an interesting career as a railway man. Dating from 1870 when he has been ticket sorter on the Pittsburgh, Cincinnati & St. Louis at Steubenville, Ohio. In the same year he was telegraph operator on the Columbus, Chicago & Indiana Central at Richmond, Ind.; the following five years he was train dispatcher, and latterly chief clerk to the superintendent. From 1880 to 1885 he was superintendent of the Indianapolis & Vincennes, and from 1885 to 1888 superintendent of the Eastern division of the Chicago, St. Louis & Pittsburgh at Richmond, Ind. From 1888 to 1896, superintendent Pittsburgh, Cincinnati & St. Louis. From 1896 to 1901 he was vice-president and general manager of the Terre Haute & Indianapolis at St. Louis, Mo., and latterly in 1901, he was fourth vice-president of the Pennsylvania Lines West, and from 1902 to 1907, third vice-president of the same lines, and from 1907 to the present appointment vice-president of these lines, and also president of the Lake Erie & Pittsburgh railway.

The Watson-Stillman Company, of Aldene, N. J., and New York City, has paid fitting recognition to the fifty years of service in its employ of Mr. Richard Ward Baker by presenting to him a substantial check and extending to him a month's vacation. Mr. Baker began his apprenticeship in a small factory in Grand street on the second day of June, 1864, and has been continuously identified with the Watson-Stillman Company and its predecessor ever since. A special resolution was passed by the board of diretcors of the Watson-Stillman Company, expressing its high esteem of Mr. Baker's long and loyal service.

L. R. Pomeroy, a railway and electrical engineer of prominence, has been appointed manager of the New York sales office, 16-24 W. Sixty-first street, of the U. S. Light & Heating Company, the general offices of which are now at Niagara Falls, N. Y. Mr. Pomeroy has under his direction the sales of the U-S-L Axle Electric Car Lighting Equipment, U-S-L Electric Starter and Lighter, and U-S-L Storage Batteries in the territory of the New York branch office.

L. R. POMEROY.

Mr. Pomeroy has long been engaged in work in the railway and electrical fields, and enjoys the reputation of being an authority along several lines in each industry. He was born at Port Byron, N. Y., in 1857, and attended high school at Milwaukee, Wis. He entered railway

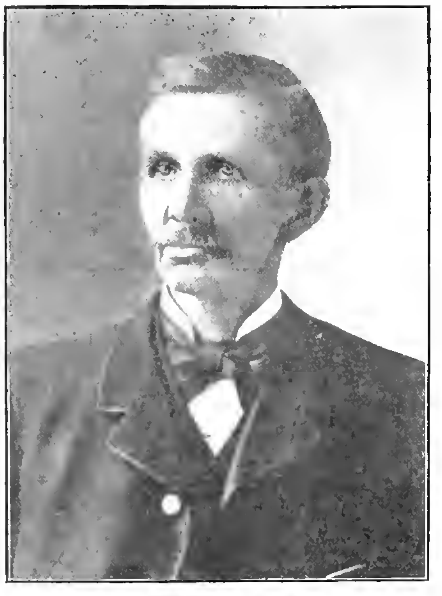
service and from 1880 to 1886 he was secretary and treasurer of the Suburban Rapid Transit Company, of New York. For four years following this he was a special representative of the Carnegie Steel Company, introducing basic boiler steel for locomotives and special forgings for railways. For nine years he was engaged in the same work with the Cambria Steel Company and the Latrobe Steel Company jointly. From 1899 to 1902 he was assistant general manager of the Schenectady Locomotive Works. For six years following this he was a special representative in the railway field for the General Electric Company, this work covering the electrification of steam roads and the general application of electricity for all railway purposes. Following this he was for two years assistant to the president of the Safety Car Heating & Lighting Company, during which period he devoted a portion of his time to consulting work in the special field of railway shops and machine tool operation. From the safety company he went with J. G. White & Co., New York, as chief engineer of the railway and industrial division. Before becoming associated with the U. S. Light & Heating Company he had an office at 50 Church street, New York, and served a large clientele as consulting engineer.

Mr. Harry A. Worcester has been appointed General Manager of the Cincinnati Northern, with offices at Cincinnati, Ohio. Mr. Worcester is a graduate of Yale University. He entered railway service in 1885, as assistant station master New York Central & Hudson River at the Grand Central station in New York City. In 1891 he entered the service of the Lake Shore & Michigan Southern as clerk at Buffalo, N. Y., and was assistant train master of the Franklin division in 1892 and 1893, and from 1893 to 1896 he was superintendent of the Lansing division at Hillsdale, Mich. From June, 1896, to November, 1902, he was superintendent of the Detroit division of the same road, and from November, 1902, to February, 1905, superintendent of the Eastern division of the same road, and in 1905 he acted for a short period also as superintendent of the Western division of the same road, and latterly in the same year as assistant general superintendent of the Michigan Central railroad. From November, 1905, to February, 1906, he was general superintendent on the same road, and from February, 1906 to October of the same year he was general superintendent of the Lake Shore & Michigan Southern, and from October, 1906, to the present year he has filled the position of assistant general manager of the Cleveland, Cincinnati, Chicago & St. Louis railway. His appointment as General Manager of the Cincinnati Northern is the fitting reward of a notable career as an accomplished railway man.

OBITUARIES.

Wm. C. Chapman.

We regret to announce the death of Wm. C. Chapman, who was for many years in the mechanical department of the Chicago & Northwestern, part of the time as master mechanic or general foreman of divisions. Mr. Chapman was born in New York State and remained there until he was about twenty years old, when he went to Chicago and entered the employ of the Chicago & Northwestern, where he remained during the whole of his working career. He moved West with the extension of the railway, locating at Dunlap, Ia., in 1867, where he remained until 1882,



WM. C. CHAPMAN.

when the shops were removed to Eagle Grove, Ia., where he remained six years, when he moved to Fremont, Neb., where he remained to the end of his working life in 1902. During the later years of his life Mr. Chapman stayed with relatives in Columbus, O., and died there March 16 last, having nearly reached the 82nd year of his age. He was long an agent of RAILWAY AND LOCOMOTIVE ENGINEERING, and was an interested reader of the paper till the end of his life. His wife and one daughter are left to mourn the loss of our friend.

Alexander Stewart.

We regret to announce the death of Mr. Alexander Stewart on June 28, in Paris, France. Mr. Stewart began his railroad career as a machinist with the Union Pacific, and later became Master Mechanic on this road. In 1903 he entered the service of the Southern Railway as a division master mechanic, and in 1906 became general superintendent of motive power and equipment. Mr. Stewart was a delightful character and was noted for his executive ability and success as an organizer.

NOTES.

Conventions in 1915.

The executive committee of the Air Brake Association has decided that the 22nd annual convention of the association will be held in Chicago, Ill., May 4-7, 1915, inclusive. The convention headquarters will be the Hotel Sherman.

It is announced that the seventh annual convention of the International Railway Fuel Association will be held May 17-20, 1915, at Chicago, Ill.

Railway Construction in Hungary.

The building has just begun in Szeged, Hungary, of a large foundry and machine shops for the Hungarian State Railways, and at the same time the railway trackage will be increased, a new station will be built, and the central railway station of Szeged will be greatly enlarged. The work will require at least three years and the expenditure of a sum of about $4,000,000. After Budapest, Szeged is the most important railway center in Hungary, and upon completion of the works described, the Szeged station will be the second largest in Hungary. The city of Szeged has a population of about 120,000, and is reached by express train from Budapest in four hours.

American concerns interested should correspond, preferably in German, direct with the central office of the Hungarian State Railways, the address of which is as follows: Magyar Kiralyi Allami Vasutak, Andrassy-ut, Budapest, Hungary.

Ignoring the Sabbath Day.

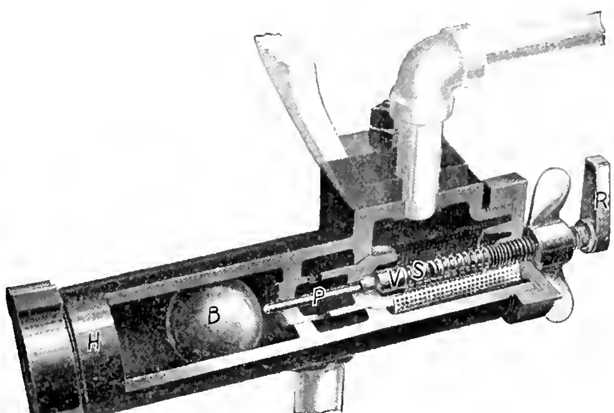
One of the first innovations effected by Mr. H. W. Thornton, who went from the Long Island Railroad to be general manager of the Great Eastern Railway of England, has been the dispatching of Sunday trains to carry the Sunday newspapers to the leading towns on the Great Eastern system. The new accommodation has been well received by the general public, but strangely enough some of the leading engineering publications have hurled the denunciation at Mr. Thornton that he is violating the commandment "Remember the Sabbath day to keep it holy."

Extensions on the Burlington.

Second tracking of the Burlington between Chicago and St. Paul and Minneapolis will be pushed as vigorously this summer as last, it is said. Something over 250 of the 442 miles of this line is now double tracked and it is believed the entire work will have been finished in another twelve months. This season the second track construction will be on the river division between Savannah and the Twin Cities.

Detroit Automatic Flange Lubricators.

The American Railway Master Mechanics' Association having strongly endorsed flange lubrication, any discussion in regard to the advantages and economies resulting from the system at this time is unnecessary, and it is a mere matter of applying the lubricant on the wheel flange in the simplest and most effective way. To this end a number of clever devices have been placed upon the market, and among them that perfected by the Detroit Lubricator Company has already come into much popular favor. It is the product of the experience, skill and manufacturing facilities of the largest and oldest manufacturers of lubricating devices in the world. It consists of an oil tank or reservoir mounted in any convenient position and a feed nozzle on the flange; between these is a ball valve which controls the flow of oil from the reservoir to the flange. As shown in the accompanying illustration the valve consists of the lubricator body H, which contains a ball B, and the plunger P, operating the valve V. The lubricator body is installed on road engines with the regulating screw pointing toward the boiler so that any swinging or rolling motion in curves or lateral motion of any kind will cause the ball B to roll against the plunger P, unseating the valve V momentarily and permitting the oil to flow on the flange. The lift of the valve V and consequently the amount of the oil feed are controlled by the tension of the spring S, which is regulated by the regulating screw R.



DETROIT AUTOMATIC FLANGE LUBRICATOR.

The lubricator is attached on switching locomotives parallel to the boiler, instead of at right angles to it, so that shocks at either end of the locomotive such as are caused by quick stops or in coupling cars operates the lubricator. It can be installed to lubricate one, two, three or four wheels as may be required. It thus acts automatically, and gives lubrication at the time that it is needed. It requires no kind of manipulation, and after being properly adjusted it does not need the daily adjustment. The absence prevents the oil spreading on the rail, and is also free from freezing. Any kind of oil that will flow freely can be used, and, as is well known, its use greatly increases the mileage and decreases the maintenance on locomotive tender and car wheels. It has been clearly demonstrated that the appliance has reduced derailments from flange climbing to a minimum, not speaking of the saving in the avoidance of damages to locomotives, cars, freight and track.

A Railway in the Clouds.

In no other way can the visitor to Peru view such magnificent scenery or experience in a day such varied climatic conditions as by making a trip of 138 miles over the highest railway in the world. The standard gauge Central Railway climbs without racks from sea level at Callao to pierce the Andes through the Galera tunnel at an elevation of 15,665 feet, dropping thence to Oroya on the Atlantic slope at 12,180 feet. There are 106 miles of steady 4 per cent. gradient, sixty tunnels, thirteen "switchbacks" and sixty-seven bridges, including the Infernillo (Little Hell) spanning a deep gorge between vertical faces, the train emerging from one tunnel only to dash into that opposite. The Morococha branch crosses the range at the great elevation of 15,865 feet. Fruit and market gardens, sugar plantations, Inca ruins, mines and smelters are passed en route. From Oroya the line stretches down a beautiful valley to Huancayo, whence it is being built toward Ayacucho, eventually intended to be joined up with the proposed extension of the Southern Railways from Cuzco and form a link in the Pan American Railway. Connection also is made at Oroya with the Cerro de Pasco Railway to Junin, Cerro de Pasco and Goyllarisquisga.

The New York, Philadelphia & Norfolk has contracted with The Union Switch & Signal Company to install a 44-lever improved Saxby & Farmer interlocking machine and plant at Salisbury, Md., at the crossing and junction with the Baltimore, Chesapeake & Atlantic. The plant will be purely mechanical with detector bars. All signals will operate in the upper right-hand quadrant, four of them in three positions, the rest in two. This is an improvement worthy of wide imitation, for there are many crossings and junctions badly in need of protection that interlocking ensures.

R. R. NOTES.

The Erie has ordered 10 passenger cars from the Pullman Company.

The Batesville Southwestern is in the market for 60 flat cars, it is reported.

The Grand Trunk has placed an order for four locomotives for suburban service.

The Union Pacific, it is said, has ordered 107 steel passenger cars from the Pullman Company.

Phelps-Dodge & Co., New York, have ordered 25 ore cars from the Pressed Steel Car Company.

The Northern Pacific has ordered 2,450 tons of bridge material from the American Bridge Company.

The Public Belt, of New Orleans, has ordered two locomotives from the Baldwin Locomotive Works.

Solvay Process Company has ordered 50 steel hopper cars from the American Car & Foundry Company.

The Cumberland Valley has ordered 2,500 tons of standard rails from the Pennsylvania Steel Company.

The Seaboard Air Line has ordered 5,000 tons of standard rails from the Pennsylvania Steel Company.

The St. Louis, Brownsville & Mexico is completing negotiations for the purchase of 800 box cars and 20 cabooses.

The Chicago & North Western has ordered 250 Rodger ballast cars from the American Car & Foundry Company.

The Chicago & North Western has ordered 250 ballast cars, to be built by the American Car & Foundry Company.

The Cuban Central has ordered 13 ten-wheel and one consolidation locomotive from the American Locomotive Company.

The Chicago, Indianapolis & Louisville has ordered 5 Santa Fe type locomotives from the American Locomotive Company.

The Northwestern Iron Company, of Mayville, Wis., has ordered a six-wheel locomotive from the Baldwin Locomotive Works.

The Chicago & North Western has ordered 25 mikados and 15 Pacific type locomotives from the American Locomotive Company.

The New Orleans & Northeastern has ordered three mikado and five Pacific type locomotives from the Baldwin Locomotive Works.

The United Railways of Havana have ordered three saddle-tank, six-wheel switching locomotives from the Lima Locomotive Corporation.

The New York, Susquehanna & Western has given an order for 1,500 tons of standard section rails to the Carnegie Steel Company.

The Kansas City Southern is expected to place a contract for 500 ballast cars with the American Car and Foundry Company, it is reported.

The Cleveland, Cincinnati, Chicago & St. Louis, it is reported, will soon be in the market for 2,500 coal cars and 4,500 steel-underframe box cars.

The Chicago & Western Indiana has ordered 805 tons of bridge material from the Lackawanna Bridge Company for viaducts at Crawford and Cicero avenues, Chicago.

The Seaboard Air Line is reported in the market for 400 steel underframe ventilator box cars, 12 coaches, 9 passenger and baggage, 5 mail and baggage and 7 mail cars.

The New York, New Haven & Hartford recently ordered 9,000 tons of rails, the order being divided between the Bethlehem Steel and the Pennsylvania Steel companies.

The Seaboard Air Line has awarded the Federal Signal Company contract for signal material at the Santee River bridge of the Carolina, Atlantic & Western, at Andrews, S. C.

The Chicago, Rock Island & Pacific should retire about 20,000 cars and expend about $15,000,000 for new cars, according to the report of E. W. McKenna to the bondholders.

The St. Louis, Brownsville & Mexico has ordered 800 box cars from the American Car & Foundry Company, and 20 caboose cars from the Mt. Vernon Car Manufacturing Company.

The Jones Purchasing Agency, Minneapolis, Minn., is in the market for 30 side outlet dump cars and a number of 100,000 lbs. capacity coal cars that could be released on car trust plan.

The Louisville & Nashville has ordered 1,500 tons of steel rails from the Tennessee Coal, Iron and Railroad Company. This rail will be used in improvement work on the North and South Alabama division of the line.

Books, Bulletins, Catalogues, Etc.

Baldwin Locomotive Works Record.

Record No. 78, containing descriptive matter and illustrations of 26 locomotives for industrial and contractors' service, has just been issued by the Baldwin Locomotive Works, and maintains the high standard of the Company's publications. The locomotives described represent seven distinct wheel arrangements and cover a number of gauges, and they serve to indicate the variety of types which are used in this class of work. Information is given covering the hauling capacity of each locomotive, at slow speed, on grades up to six per cent., besides the reasons for special designs of engines are pointed out as the nature of the service frequently requires special equipment not only in the way of brakes, couplers, head-lights and other fittings, but clearance limits are frequently restricted; curves are unusually sharp, and grades steep. Local conditions at times compel the use of fuel and water of inferior quality, and the boilers, with their accessories, must be designed accordingly. In brief it may be stated truly that in no branch of the steam locomotive industry are experience and ingenuity required to a greater extent than in the designing and building of locomotives for industrial and contractors' service, and all interested should secure a copy of the Record, which may be had on application, at the company's office, Philadelphia, Pa.

Mechanical Engineers' Journal.

The June number of the *Journal of the American Society of Mechanical Engineers* contains a number of excellent articles on welding. The various processes are described and illustrated, including the welding of metals with liquid fuel, the oxy-acetylene process of welding, the thermit process of welding, and electric welding. There is also a topical discussion on large steam power plants by a number of the members of the mechanical engineers' society and their views are of much value, being as they are the result of much scientific experiment.

Robinson Superheater.

A fine chart of the Robinson Locomotive Smoketube superheater has been published by the Locomotive Publishing Company, of London, England, and copies may be had on application to the Superheater Corporation, 9 Bridge Street, Westminster, S. W., London. As a sample of the engraver's art the chart is excellent. Attached is a full description of the details of the various parts, which differ in many important particulars from other superheating appliances. The method of expanding the two ends of the tubing into the bottom of the header is very clearly shown. In the Robinson design the superheater pipes extend back to a distance of about twenty inches from the fire-box tube plate, and the temperature of the steam after passing through the superheater is about 650 to 680 degrees Fahr. The chart also contains drawings of the tools used in disconnecting the superheater tubes from the header, which operation is accomplished without in any way damaging them, when they may be easily replaced.

Oxy-Pintsch Metal Cutting and Welding.

The Safety Heating & Lighting News of last month contains a particularly interesting description accompanied with illustrations of metal cutting and welding with Pintsch gas.

After much careful research and development work, a metal cutting and welding torch has been developed by this company. The possibilities in the use of Pintsch gas for high temperature flame work, and the availability of Pintsch gas in the railway field was recognized as of immense value in the solution of the problem of economical metal cutting. Pintsch gas, on account of its high calorific value and characteristic stability, or resistance to pre-ignition, is unusually well suited for high temperature flame work. The numerous Pintsch plants or supply stations, located throughout the United States, Canada and Mexico, supplying gas to the railroads throughout the country for car lighting purposes, can deliver the gas to the railway shops, or other points where needed, at a minimum cost and with minimum delay. A large number of the Pintsch plants or supply stations are equipped to furnish Pintsch gas at 100 atmospheres pressure, so that the necessary quantity of fuel for cutting or welding can be furnished in the most compact form, which is another factor aiding in the low cost of metal cutting by the Oxy-Pintsch cutting equipment.

Copies of the News may be had on application to the company's office, 2 Rector street, New York.

Newton Machine Tools.

This catalogue No. 48 contains 48 pages profusely illustrated with beautiful engravings that are worthy of the first class machine tools that they represent. In the forward of the catalogue the publishers say that in presenting this catalogue of Horizontal Milling Machines, they do so with confidence that a complete investigation will demonstrate the merits claimed for the machines, and with the conscious knowledge that these machines excel in the necessary essentials of: Surplus power, ample rigidity, concentrated control and productive capacity. We have given this catalogue the com-

plete investigation called for and feel assured that the claims are well founded.

We think this catalogue ought to be on the desk of every railroad shop foreman, for the machines are peculiarly applicable to railroad machine work. We cordially advise every shop foreman and master mechanic to send to Newton Machine Tool Works, Philadelphia, for a copy of catalogue No. 48.

Prophecy Concerning the Brick Arch.

The use of the brick arch in locomotive fireboxes has made its way very slowly into popularity, but it has been making its way rapidly into favor during the last few years. Mr. F. P. Roesch, now president of the Traveling Engineers' Association, is one of the ablest mechanical engineers in the country, and his opinion is worth as much as the opinion of any man we know. At the last convention he remarked, "the spirit of prophecy is resting on me now, and I wish to prophesy that the day will come, and you and I will see that day, when you would just as soon throw away the grates and expect to get results as to throw away the brick arch."

An Engineer's Prayer.

A pious old engineer on the Erie Railroad at Susquehanna years ago used to say his prayers aloud in the Young Men's Christian Association rooms before starting on a trip. An inquisitive stenographer listened one evening to this God-fearing man and noted the following petition:

"O Lord, now that I have flagged Thee, lift up my feet from the rough road of life and plant them safely on the deck of the train of salvation. Let me use the safety lamp, known as prudence, make all couplings in the train with the strong link of Thy love, and let my hand lamp be the Bible. And, Heavenly Father, keep all switches closed that lead off on sidings, especially those with a blind end. O Lord, if it be Thy pleasure, have every semaphore block along the line show the white light of hope, that I may make the run of life without stopping. And, Lord, give us the Ten Commandments for a schedule; and when I have finished the run on schedule time, pulled into the dark station of death, may Thou, the superintendent of the universe, say, 'Well done, thou good and faithful servant; come and sign the pay roll, and receive your check for eternal happiness.'"

Opposition to Frugal Labor.

In nearly every country outside of the United States a person who labors hard, saves money and becomes an employer of other labor is respected as a desirable and enterprising citizen. A different kind of sentiment is growing up and spreading through the different States forming this nation. The doctrine is disseminated that a person who rises above his class must have done so by dishonest practices. This is a most pernicious sentiment and ought to be repudiated by every right thinking man and woman.

Scotsmen Celebrate Bannockburn.

Six hundred years ago on June 26 an army of the Scottish people under King Robert Bruce encountered an English army at Bannockburn near Stirling Castle, routed them and freed Scotland from English domination. The Scots have always been proud of their countrymen's victory at Bannockburn, and as each anniversary comes around celebrations are held wherever a group of Scotsmen gather together. One of the greatest celebrations this year was held at Stirling and our chief editor, James Kennedy, read a splendid poem which he had composed for the occasion.

Highly Practical.

At a recent commencement exercise a youth who had been appointed to deliver an oration on "Light" began: "In the beginning God said, 'Let there be light, and there was light'; but none of the wonderful lights produced by modern science. It was left for the genius of the human race to invent electric light, acetylene, oil lights, gas illumination and all the other forms that have done so much to dispel darkness. I shall now proceed to explain to you some wonders of modern lighting."

The World's Population and Bad Debts.

Andrew Carnegie says that nearly all the national debts incurred by the Christian nations of the world have been formed for the purpose of promoting war and strife. European nations alone are said to owe 32 milliards of dollars.

The population of the earth is slightly over 1,900,000,000, an increase of 140,000,000 in the last four years, according to the Bureau of Universal Statistics, which has just announced its figures for 1912. Asia now has 933,000,000; Europe, 484,000,000; Africa, 188,000,000; America, 187,000,000; Oceania, 57,000,000.

The world's commerce now amounts to $40,600,000,000, and it is carried on by 55,802 sailing ships and 47,714 steamers. Other figures show a total of 625,000 miles of railroads, or enough to girdle the globe 25 times.

Agents Wanted.

Messrs. Spon & Chamberlain, publishers of popular books on mechanical subjects, desire agents to represent them at various railroad shops. Interested parties should communicate with them at 123 Liberty street, New York City.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

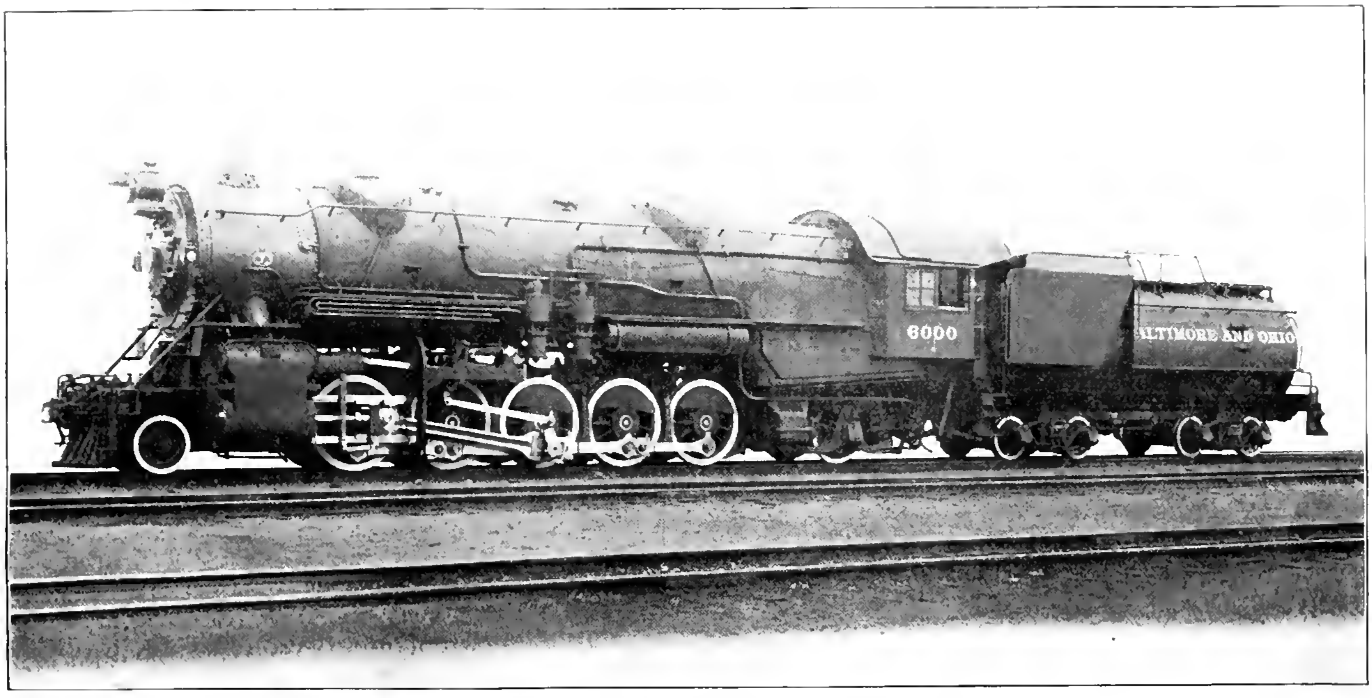
Vol. XXVII. 114 Liberty Street, New York, August, 1914. No. 8

New and Powerful Type of Locomotive for the Baltimore & Ohio Railroad

The Baltimore & Ohio R. R. has recently placed in service a large locomotive of the 2-10-2 type which was built by The Baldwin Works. This engine develops a tractive force of 84,500 pounds, and marks an interesting step in the development of the non-articulated locomotive for heavy freight service. The tractive force exceeds that of many Mallet articulated locomotives of the 2-6-6-2 type; while at the same time, the speed capacity of the Baltimore & Ohio locomotive, and the simplicity of its construction, especially as far as the driving mechanism and steam piping are concerned, commend it for heavy road service where operating conditions are severe and engines must be kept in service for a maximum proportion of the time. Such conditions are frequently met when business is heavy and there is a shortage of power.

This type of locomotive is a development of the Mikado, or 2-8-2 type, having the same advantage as far as high relative steaming capacity is concerned. The ratio of adhesion of the Baltimore & Ohio locomotive is approximately 4. Many successful locomotives are operating with a ratio as low as this; and with reasonably careful handling and a proper use of sand, the full starting tractive force can be developed under ordinary service conditions. It is also possible, with such a ratio of adhesion to work the engine at a comparatively short cut-off in slow-speed service, and thus realize the economies which result from using the steam expansively. In a saturated steam locomotive having large cylinders, there are serious losses due to condensation when running in this way; but these losses are avoided when superheated steam is used.

The boiler of the Baltimore & Ohio locomotive is of the straight top type with a combustion chamber 28 inches long and tubes 23 ft. 0 ins. long. The third ring in the barrel is tapered, with the slope placed on the bottom in order to give a free entry to the throat. The equipment includes a Security sectional arch and a Street mechanical stoker. Both these appliances are being used with marked success in the Mikado type locomotives in service on this road. The superheater is of the Schmidt type, and is composed of 48 elements. The dome is of pressed steel, measuring 33 inches in diameter and 12 inches in height. Owing to restricted clearance limits, the whistle is tapped into the side of the dome and placed in a horizontal position and the safety valves are screwed directly into the boiler shell.



2-10-2 TYPE OF LOCOMOTIVE FOR THE BALTIMORE & OHIO RAILROAD.

F. H. Clark, General Superintendent Motive Power. Baldwin Locomotive Works, Builders.

The cylinders are each cast in one

piece with a half-saddle, and the castings are bolted to the smoke box, and to each other, by double rows of 1¼ in. bolts. The steam distribution is controlled by 16-in. piston valves, which are driven by Walschaerts motion and set with a lead of ¼ in. The valves have a steam lap of 1¼ ins. and are line and line on their exhaust edges. The Ragonnet power reverse mechanism is applied. No vacuum relief valves are fitted, but the cylinders are equipped with by-pass valves of the Sheedy pattern.

The cylinders and steam-chests are lined with bushings of Hunt-Spiller metal, and the piston and valve packing rings are of the same material. The piston-heads are steel forgings, of dished section, and they are fitted with bull rings of Hunt-Spiller metal. These bull rings are secured to the piston heads by retaining rings, which are electrically welded into place. The main rods are of I-section, and the main stubs are of the Markel solid end type. The side rods are of rectangular section. The knuckle pins are fitted into case-hardened steel spherical bushings, in order to allow the rods a limited amount of lateral flexibility. A total lateral play between the rails and flanges amounting to one inch, is allowed on the front and back driving wheels; while the play on the second and fourth pairs of driving wheels is ⅜ in. The wheels of the third or main pair have plain tires, and all the driving wheels have a lateral play of ¼ in. in the boxes. With these provisions for flexibility, the locomotive can easily traverse the sharp curves on the mountain divisions of the Baltimore & Ohio R. R.

The frames are massive in section, as they have a width of 6 ins. and a depth over the driving pedestals of 7 ins. The pedestal binders are secured by three bolts on each side. The frames are braced transversely by the guide-yoke and valve motion bearer; also by cross ties placed respectively over the fourth pair of driving pedestals, and between the fourth and fifth pairs of driving-wheels. The second and fourth pairs of pedestals are also braced by strong steel castings which extend the full depth of the frames. The rear frame sections are spliced to the main frames immediately back of the rear driving pedestals, and are braced by a steel casting which serves the triple purpose of a cross tie, a support for the front end of the firebox, and a carrier for the radius bar pin of the back engine truck. The main frames have single front rails, 13 inches deep, cast integral with them, and each cylinder is secured to the corresponding frame by 16 horizontal bolts 1⅜ ins. in diameter, and by a key at the back. This provides a strong connection, with more than a liberal amount of bearing area.

The rear truck is of the Hodges type, with the spring hangers placed on an angle so that they will swing in planes tangential to the arc in which the truck swings. The first and second pairs of driving wheels are equalized with the leading truck, and the three remaining pairs with the trailing truck.

In designing this locomotive, ingenuity had to be exercised to keep the over-all dimensions within the specified clearance limits. The bell is mounted on the right-hand side of the smoke-box front, on a level with the headlight. The sand boxes are four in number, two for use when going ahead and two for backing up. They are mounted right and left, on the top of the boiler, and the corners are rounded to keep within the tunnel clearances. For the same reason the cab roof is rounded with a comparatively short radius.

The tender is of the Vanderbilt type, with capacity for 10,000 gallons of water and 16 tons of coal. The trucks have arch-bar side frames and I-beam bolsters. The wheels are of forged and rolled steel, manufactured by the Standard Steel Works Co.

The success which locomotives of the 2-10-2 type have achieved thus far, points to their increasing use for freight service where the hauling capacity of Mikado type locomotives is inadequate, and where conditions are such that Mallet locomotives could not be used to advantage. It should also be noted that locomotives of the 2-10-2 type can be built to develop high tractive forces, and at the same time carry moderate wheel-loads; so that, by using this wheel arrangement, powerful units can be built for lines having light track construction. Further particulars are given in the accompanying list of dimensions:

Gauge, 4 ft. 8½ ins.; cylinders, 30 x 32 ins.; valves, piston, 16 ins. diameter.

Boiler—Type, straight top; diameter, 90 ins.; thickness of sheets, ⅞ and 15/16 ins.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 132 ins.; width, 96 ins.; depth, front, 89½ ins.; depth, back, 75½ ins.; thickness of sheets, sides, ⅜ ins.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in.

Water Space—Front, 6 ins.; sides, 6 ins.; back, 6 ins.

Tubes—Material, steel; diameter, 5½ and 2¼ ins.; thickness, 5½ ins., No. 9 W. G., 2¼ ins., 0.125 in.; number, 5½ ins., 48; 2¼ ins., 269; length, 23 ft. 0 ins.

Heating Surface—Firebox, 258 sq. ft.; combustion chamber, 65 sq. ft.; tubes, 5,215 sq. ft.; firebrick tubes, 35 sq. ft.; total, 5,573 sq. ft.; grate area, 88 sq. ft.

Driving Wheels—Diameter, outside, 58 ins.; diameter, center, 50 ins.; journals, main, 13 x 13 ins.; journals, others, 11 x 13 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 6 x 10 ins; diameter, back, 44 ins.; journals, 8 x 14 ins.

Wheel Base—Driving, 21 ft. 0 in.; rigid, 21 ft. 0 in.; total engine, 40 ft. 3 ins.; total engine and tender, 76 ft. 6 ins.

Weight—On driving wheels, 336,800 lbs.; on truck, front, 22,700 lbs.; on truck, back, 46,500 lbs.; total engine, 406,000 lbs.; total engine and tender, 584,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 x 11 ins.; tank capacity, 10,000 gals.; fuel, 16 tons; service, heavy freight.

Engine equipped with Schmidt superheater.

Superheating surface, 1,329 sq. ft.

Material of Brake Shoes.

When railroad men had enough experience in train operating to discover that the use of brakes was absolutely necessary to control the trains, they used wooden blocks to press upon the wheels. The objections to wooden blocks were that they wore too rapidly and were apt to take fire. The spectacle of a train rushing along at full speed with all the brake blocks in flames was something striking.

The natural change from wooden blocks to rim brake shoes was vigorously opposed by some people, the inferior coefficient of friction between an iron shoe and an iron wheel being cause of poor braking. Leather-lined brake blocks were used largely on stage coaches and road wagons, so the same invention was tried by some railway companies, but they proved too expensive. In those days the expression, "There's nothing like leather," the motto of shoemakers, was shouted by cobblers, tanners and others, but as a brake shoe other materials were superior to leather. Cast iron demonstrated its superiority and won the day, but it took a number of years and a large amount of experimental work before the subject was carried to a final decision.

Pennsylvania Gives Large Order for Heavy Rails.

Last month the Pennsylvania Railroad Company placed orders for 100,000 tons of steel rails. This is the first order given out by the Pennsylvania Railroad since the business depression struck the country. This order emphasizes the tendency to use very heavy rails. All the rails will be 100 pounds to the yard, except 1,500 tons, which will be 120 pounds to the yard. That tendency towards very heavy rails is a proper movement to carry the enormously heavy rolling stock now becoming universal.

At the North British Locomotive Works

With Notes On British Cars and Couplers, Baggage Handling, Porters, Etc.

By JAMES KENNEDY

The North British Locomotive Company is a separate and distinct institution from the North British Railway Company. The company's extensive works are situated in the northern portion of the city of Glasgow. Recently the twentieth thousand locomotive was completed, and the capacity is about 700 locomotives per year. About 4,000 skilled workmen are employed, and at present the works are in operation day and night, two sets of workmen being occupied in every department being about 8,000 men.

The original company may be said to have been established coincidentally with the introduction of the locomotive, the present enterprising company being an amalgamation of several firms, the principal of which had its origin in Manchester, England, about the time that Stephenson's "Rocket" achieved its memorable success. Mr. Alexander Mitchell, a noted Scottish engineer, is superintendent of the plant, and a glance through the various sections of the works showed how thorough and complete the organization has become under his skillful management.

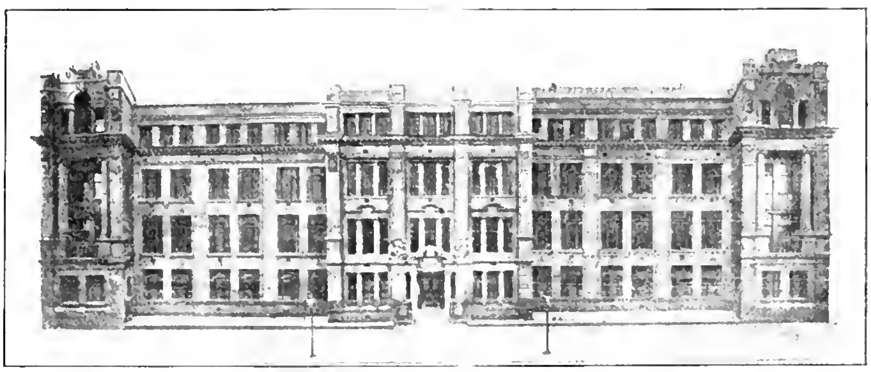
It may be said at the outset that there is a marked similarity between the works and similar works in America. This is the more marked on account of the fact that nearly all of the smaller machines in use in the works are of American make, particularly from New England. The arrangement of the smaller lathes showed a new idea in the placing of the machines in echelon; that is, instead of being in parallel lines as is generally the case, the lathes were set slantwise. The advantage is in the readiness with which pieces of work of considerable length can be placed in or withdrawn from the machines without interfering with the adjoining machine. The space between the machines is also reduced to a minimum. Probably in the matter of motive power the larger American locomotive shops could give a lesson to the Scots in the use of electric motors, the machinery of the North British works being entirely driven from shafting.

Glancing at the buildings categorically, the administration building has the majestic outlines of a city hall. Here are located the various department offices, including the drawing office, which impressed us with its immensity. Here also are a great number of large working models, nearly as large as the locomotives themselves, on which many of the principal parts of the new locomotives are planned and plotted before completing the drawings. Here also are a score or more of what may properly be called lady artists who are engaged in making tracings of the drawings and from which photographic blue prints are made. The women's work was admirable, and in marked contrast to much that we have seen pass muster elsewhere.

The template department has also features of its own not common in American shops. A special gang of men were engaged marking off on sheet plate outline models or templates of various parts for the guidance of the smiths and machinists. This was particularly noticeable in the case of the plate frames, which are literally boiler plates of extra thickness and about 4 ft. in width. The complete details are marked off on the plates, and as many as ten or twelve of these plates are slotted and drilled together. It may be added that the frame plates are first smoothly faced by being passed through a milling machine the moving table of which is 5 ft. wide by about 40 ft. in length. The progress of the parts in course of construction pass by stages to the assembling or main shop by the means of many ingenious contrivances, many of the heavy appliances being designed and made by the company's officials and workmen. They represent inventive ability of a high kind, and to these and other admirable facilities the company is partly indebted for its high position and enviable reputation.

Of the locomotives in course of construction nearly all were furnished with copper fireboxes and invariably with copper stay bolts. The brick arch was also much in evidence, while the Robinson superheater appliances were being attached to many of the boilers. The most unusual feature to an American observer, however, was the frames. The plates composing the frames were mainly from 1 to 1½ ins. thick and from 18 to 25 ins. wide. They are secured to each other by cross-plates and what are known as angle-steels. These main plates are supplemented by secondary plates much lighter and narrower, and on the top of which rests a flat steel plate which serves as a running board. In regard to the durability of these plate frames it is claimed that frame breakage on British locomotives is absolutely unknown.

Of the common method of placing the cylinders with their attachments of pistons and connecting rods with eccentrics and running gear inside the frames, it is claimed to be much more stable and durable than those locomotives equipped with outside cylinders, but it is noticeable that, since the general introduction of the Walschaerts valve gear, outside cylinders are appearing in considerable numbers, and the opinion among the railroad men generally is that the newer form is much more convenient not only in construction and repair, but particularly in the matter of adjustment.



ADMINISTRATION BUILDING OF THE NORTH BRITISH LOCOMOTIVE COMPANY SPRINGBURN, GLASGOW, SCOTLAND.

In regard to the handling of the locomotive in service, it may be justly stated that the British locomotive engineer is a thorough master of his engine. The locomotives weighing only from fifty to one hundred tons, the operation is light and the manipulation of the parts comparatively easy. The starting of the train strikes a stranger as something new. The movement is hardly felt. One is moving through space before being aware of it. It is accomplished in this way. The cars are coupled by screws having alternately right and left hand threads. The screws, which are 2 ins. or more in diameter, are attached to the cars by coupling pins and the two ends projecting towards each other are attached by an adjustable threaded nut also having a right and left thread. Through the center of this nut there is a lever suitable

for turning the nut by hand, and it is part of the conductor's or guard's duty to make an occasional turn on the nut, so that the two pairs of bumpers are kept in constant touch with each other, with a certain amount of tension on their spiral springs. The result is that in starting or stopping the train the degree of smoothness, as we have already stated, is perfect. The traction is therefore through these screws, but it would require a screw of more colossal dimensions to withstand the power of the Virginian mallet or the Erie triplex compound. That its operation in British railway service is a success is beyond question.

TRACING OFFICE, NORTH BRITISH LOCOMOTIVE WORKS.

In referring to British railway cars it might not be amiss to allude to the fact that many of the cars, or coaches as they are called, are now constructed with a corridor running along one side of the car. The original inventor no doubt intended that these corridors should connect with each other, and so permit the passengers to pass from car to car if they so desired. It was a vain thought. It naturally happens that in the vicissitudes of travel the cars are frequently turned end for end, and the corridor is of little or no service, one car having the corridor at the right side, while the adjoining car will likely have the corridor at the left side, and the accidental coming together all one way at the same time never happens, except when the royal family is taking a jaunt, which seems happening all the time; but as nobody else is allowed to ride on the same train with their royal highnesses, the advantage is not visible to the common people. In ordinary traffic the bewildered passengers who may be separated by the force of circumstances can no more get near each other than can the animals in the zoological gardens.

While the cars themselves are nearly as plain and unadorned as the granite walls of the houses, there are artistic touches of real beauty here and there. This is particularly the case with the fine armorial bearings which emblazon the sides of the tenders and also on the center panels of the cars. These are exquisite works of art, and are enameled so that they are impervious to the weather, and retain their gorgeous brilliance through summer's heat or winter's snow.

The handling of baggage is deplorable. As each division point is reached there is a rush for the baggage like a storming party attacking a fortification. The trunks and handbags are all promiscuously tumbled together like children's shoes at a Sunday school picnic, and it takes an able bodied man to find his belongings. The porters are too busy looking for sixpences to be of any service in the matter. Yet in spite of the antedeluvian methods and highway robberies there is a hollow serenity about the British traveling public that is beautiful to contemplate. The refreshment rooms are also traps for the unwary. The trains are usually late and the advertised ten minutes at some stopping point is much shortened with the result that the refreshment is more of an aggravation than a solace.

Improvements come slowly in all things British, but the advent of an American railway man as manager of the Great Eastern railway of England opens a new vista that may let a flood of light in upon them. The Great Eastern is among the best railways in the world. It was the work of very eminent British engineers, and all it needs are new methods.

A word may be added in regard to the exact size of the average high speed passenger locomotives in use. The following are the dimensions of one taken from a large number of the same class recently built by the North British Locomotive Company and now running on the Glasgow and Southwestern railway:

Gauge—4 ft. 8½ ins.

Cylinders—21 ins. by 26 ins

Driving wheels—diameter, 78 ins.

Bogie wheels—diameter, 44 ins.

Rigid wheel base—15 ft.; total wheel base, 27 ft. 11 ins; wheel base of engine and tender, 55 ft. 8½ ins.

ERECTING SHOP, NORTH BRITISH LOCOMOTIVE WORKS.

Boiler pressure—180 lbs.

Heating surface—firebox, 130 sq. ft.; tubes, 1,430 sq. ft.; superheater, 445 sq. ft.; total heating surface, 2,005 sq. ft.; grate area, 24½ sq. ft.

Tractive force—17,640 lbs.

Weight of engine in working order—

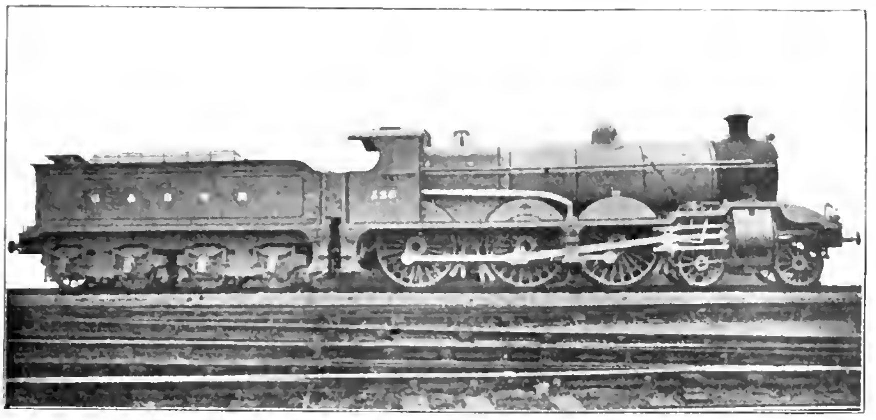
159,800 lbs., not including tender.

Weight of engine on coupled wheels—118,000 lbs.

Tank capacity—4,100 gallons.

Fuel space—180 cubic feet.

Weight of tender 113,000 lbs.



PASSENGER EXPRESS LOCOMOTIVE FOR THE GLASGOW AND SOUTHWESTERN RAILWAY, SCOTLAND.

Railway Accidents in Great Britain.

The belief prevails among many people in this country that a railway accident is a very rare occurrence on British railways, but a recent report indicates that accidents are not as rare as they are supposed to be.

All the passengers killed by accidents in England and Wales lost their lives in collisions—there being no derailments resulting in fatalities—that no passenger was killed in Scotland, and that the one killed in Ireland, who was a railway servant off duty, met his death as the result of a derailment. An apparently black record is the return of 110 passengers killed and 2,224 injured "by accidents from other causes." This is an increase of 20 in the fatal cases and of 78 in the non-fatal. The majority of these casualties are the result of want of care on the part of passengers. For instance, 40 were killed and 1,095 injured by falling when getting in or out of trains, and 723 were injured by the closing of carriage doors.

ACCIDENTS TO EMPLOYEES.

We find that 414 railway servants were killed and 5,608 injured as compared with 337 killed and 5,196 injured in 1912. On the Scottish railways there were 86 fatal and 452 non-fatal accidents, an increase of 24 in those killed and of 6 in those injured. On the Irish railways there were 16 killed and 157 injured as compared with 12 and 135 respectively. The increase of 77 in the total of fatal cases is to be found in 15 against 7 killed while moving vehicles by capstans, turntables, props, levers, etc.: 44 against 22 in miscellaneous shunting accidents; 9 against 5 by falling off trains, engines, etc., in motion: 73 against 67 while working on the permanent way, 27 against 16 from being caught between vehicles, and 46 against 28 in miscellaneous accidents. On the other hand, there was a drop from 16 to 12 in the fatal coupling cases.

An increase of 8 per cent. in the number of non-fatal casualties calls for investigation. In shunting accidents the increase was only 3 per cent. Coupling cases were unaltered, and the increase consisted principally of a rise from 694 to 729 in braking, spragging or chocking wheels, and in miscellaneous shunting accidents from 695 to 737. In accidents getting on or off engines the figures rose from 182 to 215, attending to the machinery, etc., of engines in motion from 744 to 823; walking or standing on the line from 221 to 260, being caught between vehicles from 93 to 117, and in miscellaneous accidents from 734 to 816.

The number of servants killed by the movement of trains increased from 16 to 19 on the Great Central, 14 to 22 on the Great Eastern, 30 to 35 on the Great Western, 20 to 26 on the Lancashire and Yorkshire, 36 to 46 on the London and North-Western, 8 to 15 on the London Brighton, and South Coast; 16 to 33 on the North-Western, 19 to 35 on the Caledonian, 7 to 12 on the Glasgow and South-Western, and 29 to 31 on the North British. The Midland figures fell from 39 to 36, and the South-Eastern and Chatham from 20 to 15.

One striking feature of these accidents when compared with the railway accidents in America is that the slaughter of trespassers is not mentioned. That is because the laws against trespassing on railway property are strictly enforced in Britain, while on the American continent every person seems to claim the right to use the railway right of way as freely as if the property belonged to the public.

Headlights Carrying a Plague.

A report comes from Canton, O., which may further complicate the locomotive headlight question. It seems that certain parts of the Middle West are suffering from an infection of gypsy and brown-tailed moths, the plague of Massachusetts for the last twenty years. These moths are doing serious damage to growing crops and are considered a serious menace to the farmer of Ohio.

The explanation of the spread of this plague is that the moths are attracted by the headlights of locomotives and cling to all comfortable parts of the engine.

Old Age Pensions in Britain.

The British Government have in operation an old age pensions law which is sometimes very comprehensive in action. Mr. Samuel, a public speaker, said he heard recently of the interesting fact that to a village post office in Wiltshire there came every week an old gentleman and his son and daughter, all of them to draw old age pensions. (Cheers.) The father's age was 95, his "boy's" age 73, and his "girl's" age 71. (Laughter and cheers.) The Tory party, he proceeded, was in a dilemma. They might either tax manufacturers without taxing food, and so offend the agricultural industry; and they might tax both, and so offend the masses of the people. He was reminded of the choice given to his audience by a negro preacher of taking the road that led to destruction or the one that led to perdition. "In that case," shouted an alarmed listener, "I am going to take to the woods." (Laughter.) The Tory party had the choice, said Mr. Samuel, and was now lost in the woods. (Laughter.)

Steel Car Train in Britain.

The North-Eastern Railway of England of which Lord Claud Hamilton is chairman has of late years displayed highly progressive tendencies. One of the latest enterprises undertaken by this company is the construction of an all steel passenger train to be employed on the express train service between London and Edinburgh. This will be the first steel train used in Great Britain and upon its popularity or otherwise will depend the extent of future enterprises in that line.

Help in Keeping Headlights Bright.

We commented recently upon the urgent necessity pressing upon railroad companies to see that the headlights carried by their locomotives be kept bright and clean. We are willing to add that to use the Storrs Mica Company's mica headlight chimneys is a sure help in keeping bright reflectors. We obtain this suggestion from Storrs Calendar of Railroad Meetings, which is given away free and is excellent reference for people attending such meetings. The address is Owego, N. Y. Send for it and mention the name of your adviser.

General Correspondence

The General Manager of the Westinghouse Company on "Brakes Creeping on While Running."

EDITOR:

On page 205 of the June issue of the RAILWAY AND LOCOMOTIVE ENGINEERING, there is an article entitled "Brakes Creeping on While Running." Ordinarily, we would not regard this article of sufficient importance to call for comment from us. In view, however, of the fact that the changes as suggested in the article would materially affect the successful operation of a standard piece of apparatus and because of the extensive circulation it has received through the columns of your paper, we have deemed it advisable to offer the following:

It is stated in the article that the cause of the brakes creeping on is that the feed groove opens before the exhaust port and, therefore, after a brake application from any cause (that is to say, in the ordinary manner, or by fluctuation of the feed valve, or overcharge, or any other cause), if the pressure rises slowly in the brake pipe, the piston may move back to the point where the feed groove opens, and thus the air passes from the brake pipe into the pressure chamber causing it to rise at an equal rate with the brake pipe pressure and thus not move the piston any further towards release; and since, as is claimed, the exhaust port is not open, the application chamber pressure will not be exhausted to the atmosphere, and thus the brake will not be released.

With regard to this, the assumption is incorrect, as the design of the distributing valve is no different from other triple valve devices with regard to the opening of the feed groove and exhaust port. An inherent principle of design which must necessarily be adhered to in all devices of this character is that one port must be closed before another opens, as otherwise the air would be flowing in and out at the same time; also that the exhaust port must be opened at least as soon as the feed groove.

From this it will be seen that the cause given in the article for the so-called brakes creeping on, or sticking, is incorrect—the true cause being the overcharging by one means or another of the pressure chamber, no doubt largely contributed to in certain cases by a packing ring that is not as free from leakage as it should be. For example, the distributing valve being close to the source of air supply to the brake pipe and thus subject to the very rapid rise of brake pipe pressure when full release position is being used, the pressure chamber is quite likely to be rapidly charged and when the brake valve is returned to running position the pressure in the brake pipe will drop towards the rear end of the train faster than the pressure chamber pressure can reduce back through the feed groove to the brake pipe and, because of this, the equalizing piston and slide valve will be moved toward application position. As, after this, under many circumstances the rise in brake pipe pressure will result but very slowly, it is possible in such a case for the equalizing piston of the distributing valve not to return to release position, which is almost certain to be the result if the packing ring of the equalizing piston is not in as good a condition as we prescribe. Thus we have a stuck brake, and it will be seen that it results from precisely the same cause as with other types of triple valves, namely, such a condition of packing ring that the pressure in the auxiliary reservoir is not prevented from rising at the same rate, or thereabouts, as that of the brake pipe. Another cause for a brake failing to release, and this must of necessity be true of any brake mechanism, is a closure of the outlet from the brake cylinder to the atmosphere. If there were no such means for closing the exhaust port, obviously the brake could not stick and, therefore, there could be no "stuck brakes," and should that portion of the slide valve be cut away as described in the article referred to there would be no means for retaining application chamber pressure when the brake valve handle is returned to running position, consequently no stuck brake. Ordinarily, if this material were cut away, the brake could not be applied, but in the "ET" Equipment, there are several means in the different devices for closing this exhaust port, namely, the equalizing slide valve, the engineer's brake valve and the independent brake valve. Thus, it follows that the brake valve may be applied and held applied with the distributing valve where it would not be possible with triple valves, etc., as they are installed. It so happens that on a "lone" engine, or when handling a train with one engine, the equalizing slide valve means for closing the exhaust port is not required with the distributing valve, since the outlet to the atmosphere is closed by the engineer's brake valve in all positions but running position. Also, it can be closed when the engineer's brake valve is in this position, if desired, by moving the independent brake valve to lap position. However, a different set of conditions exists when "double heading," for on the second engine the brake valves are not being used and are in such a position as to leave the outlet from the application chamber to the atmosphere open as far as the brake valves are concerned. Thus the equalizing slide valve is then the only means remaining for closing the exhaust port, and if the metal which serves this purpose is cut away, it is plain that the brake cannot be applied. This is precisely what (according to the article) was done, i. e., cut away the metal which closes the outlet to the atmosphere when the valve is in service position. While the effect of this would not be noticed with a single equipment, it entirely destroys the service application of the brake when there are two equipments "double-heading"; that is to say, on all locomotives in the train except the one used for operating the brakes. Also, with the brake valve handle in running position, the brake on the engine will not apply by opening the conductor's valve or by a parting of the train.

We have endeavored to show by the foregoing explanation that to indulge in the practice as described in the article in question would not only be ineffective but dangerous in service, and that as the cause of the trouble is either in the condition of the equipment or improper manipulation, the remedy lies in the correction of these factors.

In fact, the case in question is only another example of the limited viewpoint liable to be taken by any one who is not actively engaged in the designing and development of apparatus of this kind. While we as air brake manufacturers endeavor to encourage suggestions of improvements or new ideas of any kind, it is not only proper but essential, in justice to users of the apparatus as well as ourselves, that changes in the detail construction should not be made by others, or at least without due consideration and approval.

The Westinghouse Air Brake Company.
A. L. HUMPHREY,
Vice Pres. & Gen'l Mgr.

Pittsburgh, Pa.

Setting Slipped Eccentrics.

EDITOR:

Hand books on the locomotive gives different ways of setting slipped eccentrics, but I follow a method that is very simple and expeditious. I think it ought to be familiar to enginemen for it will be a long time before all the link motion engines find their way to the scrap heap.

For a back-up eccentric, place that side of the engine on the forward center, move the throw of the eccentric down and then move it forward towards the pin enough to give the amount of lead, and fasten.

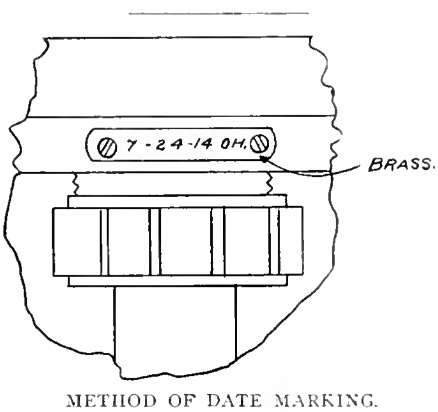
For a go-a-head eccentric, place the engine on back center and proceed in the same way as with the other.

It is no trouble to set eccentrics if the engineer knows where they ought to be. He ought to make himself familiar with the proper location of the eccentrics before the necessity arises for setting one.

There have been cases on this road of engineers turning eccentrics all over the driving axle in search of the trouble where a broken valve yoke was preventing the engine from moving.

S. R. B.

Buffalo, N. Y.



METHOD OF DATE MARKING.

Date Marking on Pump Overhauling, and Air Pump Swabbing.

BY F. W. BENTLEY, JR., C. & N. W. RY., MO. VALLEY, IA.

Records of pump overhauling is something which many shops keep a careful record of by book notations. This is practicable as long as the records are carefully kept, but it also happens frequently that pumps are taken from engines in emergency, when if the record of pumps is maintained by engine number, the record is made incorrect and the pumps often misjudged.

The above sketch is descriptive of a method used by the writer for dating the time a new pump goes into service and by which its time in service can be instantly ascertained on the pump itself. A small plate of thin sheet brass is held by small tap screws to the upper outer flange of the center piece. Being of brass it will not corrode and the stamped dates on it are always ready for instant inspection in the shop or on the road by the traveling engineer.

Air pump piston swabbing if wound upon the common strip of sheet metal generally used as a band frame, is prone to bake and the oil readily leaves the swab. If the swab is tight to the piston to any extent, the thin end of the band soon cuts the swabbing in two.

The other sketch is descriptive of a swab frame which the writer has used and applied with a great deal of success. The slot on the end makes it very easy to apply and the projections on its top and bottom which are made by cutting away some of the body of the frame, keep the swabbing clear of the hot packing nuts.

The swabs are also much easier to oil with a frame of this nature, and the small amount of extra work in cutting or stamping them out will repay itself in the life and serviceability of the pump piston swabbing.

Master Boiler Makers' Convention and Locomotive Boilers.

EDITOR:

I have read all the Proceedings of the Master Boiler Makers' and there is really no recommendation there which will increase the safety or strengthen the locomotive boiler. This in the face of information published by your paper from efficient engineers, motive power superintendents, boiler makers, etc., would indicate that the wheels of Progress are clogged.

The same old story is told about leaky flues and welding flues, flexible bolts and the troubles appertaining thereto, apparently no improvement, only an endless cycle.

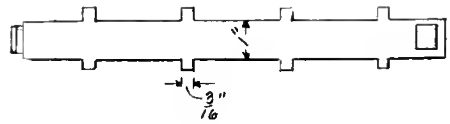
You can see advertisements of loco boilers with complete installation of the so-called flexible stays, which viewed from the standpoint of sterling worth and American intelligence ought to be regretted, as it has been clearly proved they deplete the strength of the boiler, always requiring scientific adjustment. There is nothing in them only a scientific commercial profit to the makers, and expense to the railroads.

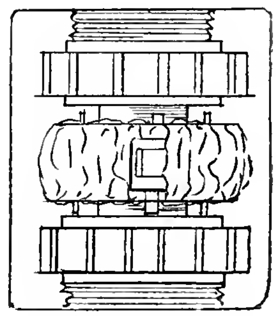
One thing I forgot to name is the return of the cycle to the old combustion chamber, which is like "chasing Satan round a stump, and every time you give him a kick, he only takes a jump." All that is claimed for it is that you get better results from the heating surface and less leakage of tubes, though at the same time you may have more trouble with broken stays, and all the trouble you want with throat sheets.

There are other ways of getting better heating surface with increased circulation. One, by the adoption of the most scientific advance in boiler construction yet known, namely, corrugated fireboxes, which have been endorsed by hundreds of engineers, boiler makers, superintendents motive power, etc.; and still you find the same old routine business of what has happened in their respective shops since the last meeting —the chief topic of debate; the greater and more important subject of new inventions and improvements in loco boilers—a dead letter. It seems there can be a boycott of improved construction, just as much as with lager beer drinkers against certain breweries, where and how can it be lifted?

WM. H. WOOD,
Mech. Engineer.

Media, Pa.





PUMP PISTON SWABBING.

S. F. Governor.

EDITOR:

I would like to start a discussion in these columns with reference to the advantage or disadvantage of the use of the excess pressure governor top used with the E. T. equipment.

I am not in favor of the use of this governor on a locomotive hauling from 80 to 100 car freight trains, and, instead, would use the S. D. type and plug the connection from the feed valve pipe.

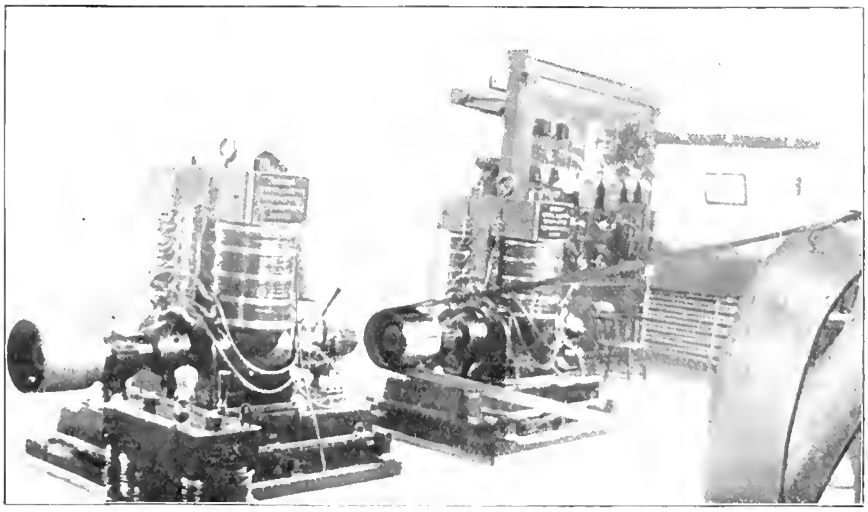
I believe it is a general practice for engineers handling long freight trains to create a leak in the operating pipe of the governor in order to accumulate a safe pressure in the brake pipe with which to handle the train under conditions whereby the pumps are throttled down by leaks that cannot be found or repaired.

By the use of the S. D. governor the pumps could not be throttled until at least a 90-pound main reservoir pressure is obtained, which will give an ample excess pressure with which to operate the

feed valve, which in turn should prevent a great deal of the troubles resulting from brakes "creeping on."

An objection that repairmen have to this governor top is, that by wire drawing the steam due to the throttling process, the steam valve and steam valve seat are badly cut after a short time in service. I believe that this throttling of the steam supply to the pump also has a bad effect of causing saturated steam to be used, resulting in undue wear in the steam valve mechanism.

J. J. JONES.
Air Brake Machinist, Beardstown, Ill.



EDISON BIPOLAR GENERATOR, CANADIAN GENERAL ELECTRIC COMPANY.

Generator Giving Good Service After 21 Years.

EDITOR:

The accompanying illustration shows two Edison bipolar generators built by the Canadian General Electric Company and installed twenty-one years ago. The generators are belted on water turbines and are supplying 500 volts of electrical energy for the operation of the locks on the Sault Ste. Marie River Ship Canal at Soo, Ontario. At the same time these generators are supplying the energy for lighting and operating the Canadian Pacific Railway swing bridge, a span of 407 feet over the above canal. The generators are connected to run in parallel and after twenty-one years are in excellent condition and giving good service to-day.

J. G. KOPPEL.
Sault Ste. Marie, Ont.

Broken Air Pipes With H-5 and H-6 Equipment.

BY J. H. HAHN AND O. H. BURGH

Much has been written on the subject of broken air pipes on the E. T. No. 5 and E. T. No. 6 locomotive brake equipments. The air brake instructors have given this part of their work very little attention, as we have never heard a lecture or read an article describing in detail what should be done on the line of road in case a certain pipe should break off to put the brakes in an operative condition so that the train may be brought into the terminal under control of air brakes. No doubt many engineers will readily see the value of this article, as it tells as briefly as possible how to repair broken pipes on the road and get away in the least possible space of time. And it is not necessary to spend any great amount of time in studying the details of the air brake.

H-5 EQUIPMENT.

Broken brake pipe branch pipe: Plug broken pipe on brake pipe side and take the drain plug out of pressure chamber. You have lost automatic brake on engine and tank, but have the straight air brake.

Broken brake cylinder pipe at distributing valve: Plug or cut out the main reservoir branch pipe to distributing valve. You have lost all brakes on engine and tender.

Broken double heading pipe: Plug at distributing valve brakes; work as before, except in case it is the second engine and should pipes then break, you would have to carry both brake valves in running position, except when the brakes are applied, then it would be necessary to move either of the brake valves to lap or holding position so the air in application cylinder could not escape to the atmosphere.

Broken application pipe: You have lost straight air brake on engine and tender. Disconnect double heading pipe to distributing valve, you have automatic brake on engine and tank.

Broken connecting pipes between main reservoirs: Use air hose and angle-cocks, and make a line in this way.

Broken brake pipe between back end of tank and the tee that brake pipe extends from to front of engine: Plug at union in brake pipe below the tee, now couple whistle hose and brake pipe hose together on front of engine, opening both cut-out cocks and couple whistle hose on back of tank to brake pipe of train. You will have all brakes.

Note.—By taking out both gaskets and turning one over so that flange will be on outside and putting a drop of oil on it, you can couple whistle hose and brake pipe hose together without any trouble.

The same break-down on freight engine not equipped with whistle signal: Set straight air brake, go to reducing valve and set it to the brake pipe pressure desired, and by watching brake cylinder gauge you can tell what pressure you have it set at, then release straight air brake, cut out the driver brake cylinders, and uncouple the brake cylinder hose between engine and tender; and couple the brake cylinder of engine to brake pipe of tank, set straight air brake; this will put reducing valve pressure in application cylinder on the left of application piston 10, which will cause it to move to the right, closing exhaust valve 16 and moving pin 18, which moves application slide valve 5 to application position, letting air flow in brake cylinder pipe. Now you have brake pipe coupled to the brake cylinder pipe so the air flows into brake pipe until brake pipe pressure on the right of application piston 10 gets equal to the air in application cylinder, when the piston 10 will move to the left, carrying pin 18 and application slide valve 5 to lap position. Now the distributing valve takes the place of the feed valve, when you set the brakes, move straight air brake to release position, make whatever reduction desired. Brake pipe pressure now becoming greater than that contained in application cylinder causing piston 10 to move to the left far enough to open exhaust valve 16. Then the distributing valve takes the place of equalizing piston. This applies to E. T. No. 5 or E. T. No. 6, and in actual practice it works perfectly, losing only the engine and tender brakes.

THE NO. 6 EQUIPMENT.

Broken application cylinder pipe; plug at distributing valve: You have lost straight air brake, but have the automatic brake.

Broken release pipe: Proceed as if nothing had happened, you have lost the holding feature of the engine and tender brakes, is all.

Broken excess pressure pipes to governor; the one that connects to the top marked F. V. P.: Plug so as not to lose feed valve pressure, now put blind gasket in union of pipe connected at the bottom of governor marked A. B. V., proceed. You can let off on maximum governor to whatever pressure desired in main reservoirs.

Maximum pressure pipe to governor broken plug at main reservoir: When brake valve is on lap, the pump will pump up boiler pressure unless governed by throttle.

Broken main reservoir branch pipe to distributing valve on a light engine where you find it necessary to have brakes, as on Rascon Villar or Salazon mountains, in helper service: Plug the pipe at distributing valve, plug brake cylinder exhaust port. Take off application slide cover, now take off application cylinder cap, and remove the piston 10, put the cap back on, now you set straight air brake, air will flow from reducing valve through straight air brake and distributing valve to the brake cylinders. By taking up slack on piston travel brakes will apply and release quickly, you can handle engine with safety.

Feed valve pipe broken off under automatic brake valve: Stop flow of air from feed valve by slacking off hand wheel 22. Place automatic brake valve in full release position and plug pipe leading to bottom of excess pressure governor by putting blind gasket in connection at governor marked A. B. V. The automatic brake valve must be carried in full release position to maintain brake pipe pressure.

Broken equalizing reservoir pipe: Plug the connection from the brake valve and plug the service exhaust opening under automatic brake valve and operate the brakes by using emergency position. To avoid quick action and prevent the head brakes from kicking off, a little care and judgment should be used.

(We are under the impression that this subject has been pretty thoroughly covered by various air brake publications and feel that some of our correspondents will take issue with Messrs. Hahn and Burgh on several of their methods of overcoming troubles with broken air pipes, especially when the application piston of a distributing valve is relied upon to do the work of the supply valve piston of the feed valve and how a service application of the brake can be made through the distributing valve exhaust port or if purposely restricted, how an emergency application could be made if necessary. We are also quite sure that a helper engine with a broken off distributing valve supply pipe can be brought down Salazon or Rascon Villor with an air brake, without dismantling the application portion of the distributing valve.—Ed.)

First Railroad in America.

EDITOR:

I have read with much pleasure the article that appeared in your April number on "The First Railroad in America" by W. P. Maher. Mr. Maher is correct in claiming that the Charleston & Hamburg Railroad was the first railroad in the United States to be operated by steam. But as your correspondent mentions the Quincy Railroad built in 1826 as having been the first railroad constructed in the United States, I feel that his letter needs correction.

In 1809 a piece of experimental railroad to carry wheeled vehicles was laid out by John Thomson, a civil engineer of Delaware County, Pa., and constructed under his direction by Alexander Sommerville, a Scots millwright, for Thomas Leiper, of Philadelphia. It was 180 ft. long with 4 ft. gauge.

The experiment was considered so successful that in the same year Leiper caused the first practical railroad in the world to be constructed. That is a railroad to be operated by wheeled wagons. Like the Quincy Railroad it was built for the transportation of stone from a quarry, and was about one mile long. It continued in use for about twenty years.

In 1816 the first railroad on which self-acting inclined planes was used was built on the Kiskominetas River in Pennsylvania.

In 1826 the construction of the Mauch Chunk Railroad was begun and finished within the year. It is a famous scenic railroad nowadays, operated by the Lehigh Valley Railroad Company, but it was used for many years transporting coal down the mountain side to the Lehigh River. The road which is still in good condition is about nine miles long.

These are real historical facts and ought to be known to the readers of "The Most Interesting Railway Paper Published." That is your own motto of long ago, when John Skeevers was still writing words of wit and wisdom.

JAMES JOHNSON.

Philadelphia, Pa.

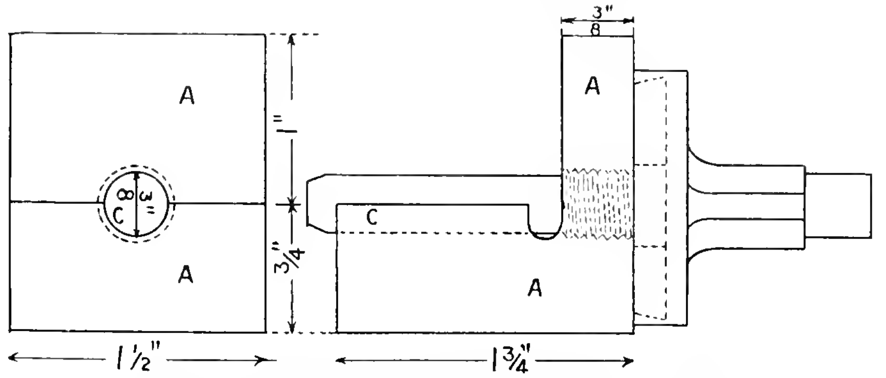
Device for Straightening Triple Valve Emergency Valve Stems.

BY J. A. JESSON, LOUISVILLE & NASHVILLE R. R., CORBIN, KENTUCKY.

The accompanying illustration shows a side and end view of a handy and useful device which the writer has designed for straightening Triple Valve emergency valve stems.

It consists of a steel block (A) tapped to receive the threaded portion of the valve, a groove (C) is an extension of the lower half of the tapping.

The condition of the stem can readily be noted while the valve is being screwed into block (A).



DEVICE FOR STRAIGHTENING TRIPLE VALVE STEMS.

Any irregularities can be corrected by lining up the stem with the groove, by striking with a soft hammer.

Fireless Locomotive.

The National Cash Register Company, of Dayton, are using a resuscitated invention in the form of a fireless locomotive. Such engines have been tried repeatedly, but they always failed in economy when run against ordinary steam locomotives.

The National Cash Register Company's locomotive is used for hauling freight cars in places where there would be danger of fire with a locomotive generating its own steam. The engine has a large tubular boiler tank, 13 ft. long and 6 ft. in diameter. The tank is filled about half full of water, and steam at a pressure of 150 pounds is injected into it from the stationary boiler plant. The steam raises the pressure in the engine to 150 pounds in about fifteen minutes, and some of it is condensed, so that the boiler is about three-quarters full of water when ready for work. When charged with steam, the locomotive will run for from two to three hours, according to the number and the weight of the cars it has to shift. As nothing passes up the stack except exhaust steam, the engine can safely be used in the timber yard, and in and near buildings filled with inflammable material. The cost of running it is small.

Wants to Subject Pullman Car Porter to Martyrdom.

The latest move towards regulating the freedom of the individual citizen is a bill introduced into Congress by a California member prohibiting persons riding in Pullman sleeping cars from giving gratuities to the car porter. The porter shines the shoes of passengers, brushes their garments and performs other courtesies which most passengers consider cheap for the quarter freely given. We doubt if a law will stand prohibiting the traveling public paying for services rendered.

Catechism of Railroad Operation

NEW SERIES.

Third Year's Examination.

(*Continued from page 260, July, 1914.*)

Q. 44.—What is a valve motion?

A.—Any mechanism that will control the movement of valve, so as to admit steam to the cylinder and exhaust steam from the cylinder at proper intervals is a valve motion.

Q. 45.—What are the parts of valve motion and connections to valve for the "Stephenson" valve motion?

A.—The eccentric (sometimes called cam or pulley), eccentric strap, eccentric blade, link, link saddle, saddle pin (suspension stud), link hanger, link block, link block bolt, lower rocker arm, rocker shaft, upper rocker arm, rocker box, valve rod bolt, valve rod, valve stem, valve yoke and on some engines a transmission bar is used between link block and rocker arm.

Q. 46.—What are the parts of the Walschaerts valve motion and connection to valve?

A.—Eccentric crank, eccentric rod, link foot, radial link, trunnion pins, trunnion pin brackets, link block, link block bolt, radius rod (or radius bar), combination lever, union link, cross-head arm, valve rod, or valve stem, valve yoke, valve stem cross-head, valve stem guides, suspension link.

Q. 47.—What is a balanced valve?

A.—A balanced valve is one which has the greater part of the pressure kept off the top of the valve.

Note.—Generally about 65 per cent. of the pressure is removed from the upper surface of the valve, leaving a pressure sufficient to overcome the influence of the exhaust and working pressure in one end of the cylinder.

Q. 48.—How are valves balanced?

A.—By keeping the pressure off the top surface of the valve; this is accomplished by fitting strips of iron (called "balance" strips or valve packing strips) in grooves cut in the top of valve near its outer edges and supporting these balance strips on coil or elliptic springs, which hold them up against the pressure plate attached to the cap of steam chest: these balance strips form a steam tight joint with the pressure plate excluding the steam from the portion of the top of the valve which they enclose.

Q. 49.—Why are valves balanced?

A.—To reduce friction between valve and its seat.

Q. 50—What is the small hole drilled in the top of the valve for, and what is it called?

A.—It is to release any small volume of steam which may get by slightly defective balance strips, allowing it to pass out to the exhaust, in that manner maintaining the balanced feature of the valve. It is called the release port.

Q. 51.—What is the vacuum valve for, and what is it generally called?

A.—It is to relieve the vacuum formation in the steam chests and cylinders when drifting. It is commonly called the relief valve.

Note.—Many of the most up-to-date railroads are doing away with the relief valve, believing that it destroys lubrication qualities of the valve oil by admitting the oxygen, and to relieve the vacuum formation they either have a drifting valve which admits a small amount of steam to the cylinders while the throttle is closed or they instruct the enginemen to leave the throttle open a slight amount for the admission of sufficient steam to prevent the vacuum formation.

Q. 52.—What is a transmission bar?

A.—A transmission bar is a bar of steel or iron used to connect the link block to the rocker arm or valve rod connection, on engines where the rocker is placed some distance ahead of the link.

Q. 53.—What are the two different valve motions most common on our locomotives today?

A.—The Stephenson and the Walschaerts.

Q. 54.—In what way do these valve motions differ in construction of the parts?

A.—The Stephenson valve motion has two eccentrics and the reversal is accomplished by changing the controlling eccentric, which is possible because the eccentrics are attached to the shifting link.

The Walschaerts valve motion has but a single eccentric which has a connection with lower end of radial link which is suspended at its center, and the reversal is accomplished by changing the manner in which the motion is transmitted to the valve, which is possible because the link block can be moved to point above or below the point at which the link is suspended.

Q. 55.—How many ways are there of transmitting motion from the eccentric to the valve? How are these different methods designated?

A.—There are two ways of conveying motion from the eccentric to the valve and they are called the "Direct" and the "Indirect" valve motions.

Q 56.—What is a direct valve motion?

A.—A direct valve motion is one in which the valve moves in the same direction as the throw of the eccentric which is controlling it.

Note.—The connection from eccentric which is in control of valve is direct or straight from eccentric to valve.

Q. 57.—What is an indirect valve motion?

A.—An indirect valve motion is one in which the valve moves in the opposite direction to the throw of the eccentric which is controlling it.

Note.—On engines having the indirect valve motion we have the upper and lower rocker arms and rocker shaft (or the equivalent) between the eccentric and valve, as a consequence a reversal of the motion given off at the eccentric will obtain at the valve.

Q. 58.—In the Stephenson valve motion, what is the relative position of the eccentrics to the main pin for the direct valve motion with outside admission valve?

A.—The throw of the controlling eccentric will lead the main pin in the direction in which the wheel will turn, at right angles to the main pin plus the angle of advancement from the main pin necessary to get the lap of the valve out of the way and give the desired lead.

Q 59.—In the Stephenson valve motion, what is the relative position of the eccentrics to the main pin for the indirect valve motion, outside admission valve?

A.—The throw of the controlling eccentric will follow the main pin in the direction in which the wheel will turn, at right angles to the main pin minus the angle of advancement toward the main pin necessary to get the lap of the valve out of the way and give the desired amount of lead.

Q. 60.—What is the relative position of the eccentrics to the main pin with the Stephenson valve motion, with the inside admission valve and the direct motion gear?

A.—The throw of the controlling eccentric will follow the main pin in the direction in which the wheel will turn, at right angles to the main pin, minus the angle of advancement toward the main pin necessary to get the lap of the valve out of the way and give the desired amount of lead.

Q. 61.—With the Stephenson valve motion, what is the relative position of the eccentrics to the main pin for the indirect valve motion, with the inside admission valve?

A.—The throw of the controlling eccentric will lead the main pin in the

direction in which the wheel will turn, at right angles to the main pin plus the angle of advancement from the main pin necessary to get the lap of the valve out of the way and give the desired amount of lead.

Q. 62.—How is the Stephenson link carried or suspended?

A.—By the saddle pin (suspension stud) and link hanger to the lifting arm of the tumbling shaft.

Q. 63.—Why is the link saddle pin (suspension stud) placed to one side of center of link?

A.—To overcome the effect of the angularity of the main rod and harmonize the travel of the valve with the travel of the piston.

Note.—The effect of the angularity of the main rod can be overcome by the manner in which the tumbling shaft is placed, but on account of the limited space on the ordinary locomotive this method is not possible although considered the better way to get the proper distribution of steam.

Q. 64.—To what is the link block attached in the Stephenson valve gear?

A.—To the lower rocker arm or to the transmission bar which is used to carry the motion ahead to the rocker arm.

Q. 65.—How is the Stephenson geared engine reversed?

A.—The eccentrics have their blades attached to the shifting link, the go-ahead blade is connected with the top end of the link and the back-up blade to the lower end of the link, the link may be moved up and down on the link block, in that manner accomplishing the reverse by changing the controlling eccentric.

Q. 66.—How is the eccentric placed in relation to the main pin on a Walschaerts geared engine having outside admission valve and direct motion when going ahead?

A.—The eccentric will lead the main pin at nearly right angles or be a little less than one-fourth of a turn ahead of the pin when engine is going ahead.

Q. 67.—How is the eccentric placed in relation to the main pin on a Walschaerts geared engine having outside admission valve and indirect motion when going ahead?

A.—The eccentric will follow the main pin at a little greater angle than a right angle or be a little more than one-fourth of a turn back of the main pin when the engine is going ahead.

Q. 68.—How is the eccentric placed in relation to the main pin on a Walschaerts geared engine, having inside admission valve and direct motion when going ahead?

A.—The eccentric will follow the main pin at a little more than one-fourth of a turn when engine is going ahead.

Q. 69.—How is the eccentric placed in relation to the main pin on a Walschaerts geared engine, having inside admission valve and indirect motion when going ahead?

A.—The eccentric will lead the main pin a little less than one fourth of a turn when the engine is going ahead.

Q. 70.—Is the Walschaerts eccentric ever placed at exactly right angles to the main pin? If so, when?

A.—Yes, on engines where the connection between eccentric rod and the link foot is made on the dead center line of motion.

Questions Answered

Brakes Creeping On.

S. A. B., Emporia, Kan., writes: I would like to ask a question regarding action of brakes on engines with No. 6 E. T. equipment, which I am unable to understand. After making a service application with automatic brake, the release is made in running position and brakes release, but in a few seconds engine brakes will again creep on, both brake valves in running position, and releasing with independent valve will not keep them released, but they will again creep on when independent valve is returned to running position, and may be made to stay released only by movement of automatic valve to full release and return to running position. Independent applications will stay released, but it is only when automatic applications are made that this result is noticed. On the engine we have, whenever we are second engine in double heading and the head man has made an automatic application and release, our engine brakes will invariably creep on again, and it is necessary, after each application and release of head man, to momentarily cut in brake valve and make a movement of automatic brake valve handle to full release and return to running. I think this is contrary to what the instruction books say, and I would be very glad if you could tell me what is wrong.

A.—Assuming that there is no other irregularity in the action of the brake outside of those you mention, your trouble on the lone engine indicates a variation in brake-pipe pressure that is permitted by a defective feed valve, and quite likely aggravated by brake-pipe leakage. The brake applying after a release is made by the head engine in double heading, is to a certain extent to be expected, as on a long train the brake-valve handle may have been allowed to remain in release position long enough to result in a considerable over-charge of the pressure chamber of the second engine, whereupon a reapplication could be expected. A materially enlarged feed groove in the equalizing piston bushing of the distributing valve would tend toward reapplications of the brake after release, but if you will have the feed valve cleaned and made sensitive enough to permit no brake-pipe variation of over 1½ or 2 lbs., and have any brake-pipe leakage that may be found, tightened, your trouble on the long engine will quite likely disappear, and if your distributing valve is in good working condition, the first engineer in double heading will, through his methods of manipulation, be responsible for any reapplications of your brake.

Electric Condenser

R. T. M., of Baltimore, writes:—Please explain and describe the principle and construction of the electric condenser: **A.** The electric condenser as built commercially consists of plates of metal, usually tinfoil stacked up with an insulating material of a few thousandths thickness between each sheet. Each alternate sheet is connected to one terminal and the remaining sheets to a second terminal.

Although there is no contact between the sheets of tinfoil, so that electric current can flow from one terminal to the other, there will be, however, a flow of current into the condenser for a very short time if wires of different voltage are connected to the terminals. This current is called the charging current and the amount of this current and the time it flows will depend upon the voltage connected to the terminals and upon the size and number of the tinfoil sheets.

After this charging current has stopped and the wires disconnected from the terminals a certain amount of current can be taken out of the condenser. That is, a resistance can be connected across the terminals and a current will flow for a short period healing up the resistance and the condenser will become discharged. In other words the condenser stores up energy in the form of a charge which it will give up.

The condenser is used in many circuits to take up any sudden change in voltage and to give it up on low values. It serves to smooth out the variations. It also has a wider and more important application in connection with alternating current. The amount of energy the condenser will store is known as its capacity. Capacity is very necessary sometimes in electrical circuits to offset the inductance and condensers are universally used to better improve the electrical transmission of power.

Very Ancient Writings.

Our word paper comes from the ancient Egyptian word papyri, a plant which the ancients used for writing upon. There was recently discovered 17 rolls of historical papyri unearthed by a native Egyptian digging in the vicinity of a temple of the Ptolemics of upper Egypt.

All-Steel X-25 Type Freight Box Car for the Pennsylvania Railroad

In 1912 the mechanical engineering department of the Pennsylvania Railroad designed a box car having an all-steel underframe, posts and braces, which supported a wooden lining and floor. All of the steel parts being on the outside, the interior presented a smooth wooden surface.

Continuing the policy to ultimately obtain an all-steel box car, a new design is now under construction, which is known as the X-25. The car is of 100,000 pounds capacity and is equipped with 5½ in. x 10 in. arch bar or crown cast steel side frame trucks. The inside length is 40 ft. 5 ins.; width, 8 ft. 10 ins., and the height is 9 ft. 1 in., giving a cubical capacity of 2,343 cubic feet. The height of floor from rail is 3 ft. 7½ ins. The eaves are 9 ft. 2 ins. wide at a height of 12 ft. 10 ins. The length of the car over end sills is 42 ft. 6 in., and the extreme width is 10 ft. 1-9/16 ins. over side doors, the door opening being 6 ft. 0 ins. wide and 8 ft. 5¼ ins. high.

The underframe of this car is of the same general type as used in recent P. R. R. design, viz.: the weight of the superstructure and lading is transferred to the center sills by means of two pairs of cantilevers or crossbearers, and the end construction, thus eliminating the use of a body bolster.

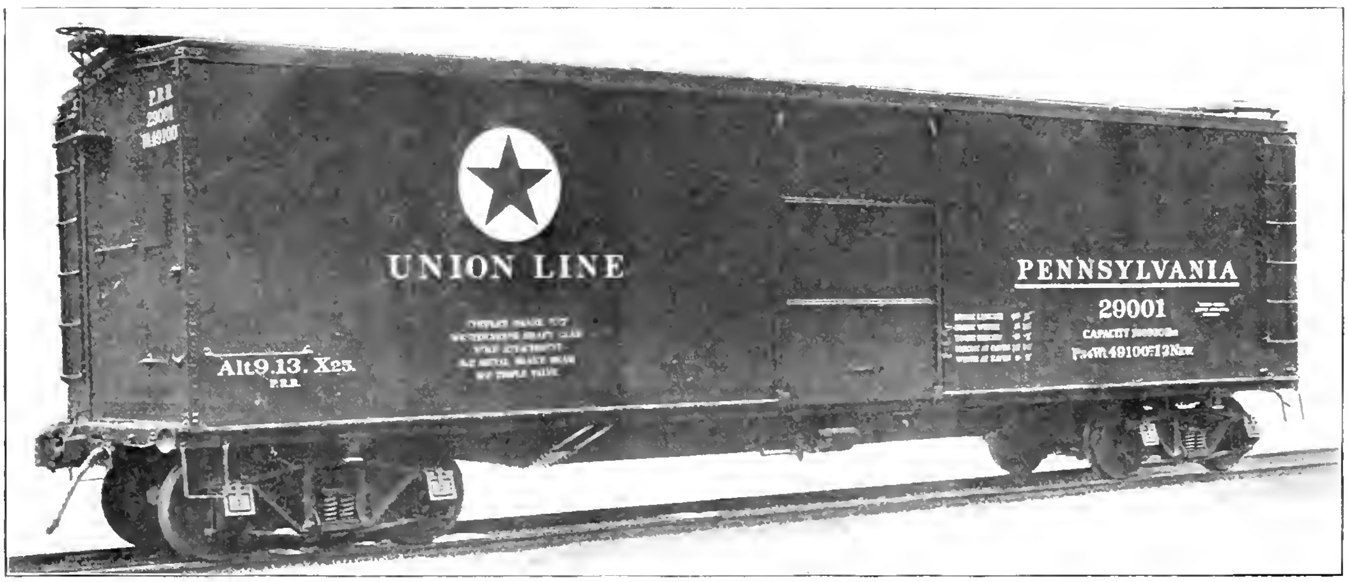
The backbone of the underframe has a minimum section area between rear follower stops of 34 square inches, and is composed of 2⅜ in. fish belly type centre channels with 4 in. flanges top and bottom, the channels being 20 ins. deep between crossbears, and taper to 11 ins. at a point 22-11/16 ins. back of the centre plate; a 26 in. x ⅜ in. cover plate riveted the full length of the centre sills, and a 4 in. x 4 in. x ¾ in. angle riveted to the bottom of each sill on the inside and extending continuously between back draft lugs, which are incorporated in the centre plate reinforcing casting.

The centre construction is also reinforced at each end by a cast steel striking plate and front draft lugs combined, a cast steel centre plate reinforcing casting above the centre plate, a cast steel spreader at each point where the crossbearers are fastened to the centre sills, and by pressed spreaders between all intermediate diaphragms. The crossbearers on either side of the centre of car are composed of two dished diaphragms of ⅜ in. thickness, having 3½ in. flanges, top, bottom and ends. The diaphragms are set 5 ins. apart and are joined together at the top and bottom by 12 in. x ⅜ in. cover plates, which extend across the centre sills and are riveted to the crossbearer flanges. The crossbearers are secured at one end to the web of the centre sill and at the other end to the bottom member of the side truss.

At the centre plate the usual body bolster is replaced by a much lighter bathtub type of diaphragm, ⅜ in. in thickness, 7 ins. in depth, and 7⅜ in. in width, which is riveted to the centre sills and side truss. This is made possible by reason of the fact that this member has to take care of the side bearing thrust only and does not carry any of the load. Above the side bearing, which is a steel casting, is a cast steel reinforcing block, and at the extreme end is a combined roping iron and jacking casting. The drop forged centre plate is secured to the flanges of the centre sills, as well as the centre plate reinforcing casting, which extends back towards the centre of the car 9 ins. from centre line of centre plate, and thus possesses the added feature of reinforcing the centre sills at the critical point, due to buffing stresses.

There are six intermediate diaphragms on either side of the car, four of which are located between the crossbearers and one midway between the crossbearer and centre plate at either end of the car. The diaphragms, which are 6¾ ins. deep and ⅜ in. thick, do not carry any of the load as their top flanges are ¾ in. below the bottom of the floor, but simply act as stiffeners for the bottom member of the side truss, and as support for the brake rigging.

The end sill consists of a Z shape plate ⅜ in. in thickness, which extends the entire width of the car, binding the side and end construction together, and 5 ins. below the top of the centre sills and is flanged inward for a distance of 8-7/16 ins. at the centre, narrowing somewhat toward either side. The back vertical leg, which is 8 ins. high, makes an excellent attachment for the end construction.



NEW TYPE OF ALL-STEEL FREIGHT BOX CAR FOR THE PENNSYLVANIA RAIROAD.

The end sill is secured at the centre to the striking plate and at either end to a cast steel push-hole pocket and corner casting, which are in turn riveted together and secured to the bottom member of the side truss and to the diagonal brace, while the top vertical leg of the end sill is riveted to the end sheets the entire width of the car. This construction of end sill fulfills all requirements of one of the most important features of freight car construction, namely, finish, strength-binding all continuous parts of the underframe together, and accessibility for repairs.

The diagonal brace is a U shaped section 8 in. wide and 3/8 in. thick, with 2½ in. flanges pointing downward. It is flattened out at both ends, being fastened to the top flange of the centre sills at one end and to the push-pole pocket and bottom side truss at the other end, and thus, by virtue of its position, transferring horizontal strains from the end sills and bottom side truss to the centre sill.

The bottom member of the side truss or side sill runs continuously between the end sills and is composed of a 4 in. x 6 in. x 3/8 in. angle and a 4 in. x 3½ in. x 3/8 in. bulb angle, which are riveted together back to back. The short leg of the angle pointing towards the centre line of car, and the long leg of the bulb pointing outward, both legs being in the same horizontal plane as the centre sill cover plate. These combined sections make an ideal combination for a car of this type of underframe, making an excellent support for the floor, there being no other longitudinal member, giving lateral stiffness to the underframe and a convenient member upon which to secure the side sheets.

SUPERSTRUCTURE.

The object aimed at in designing the X-25 car was to provide as great a protection as possible for the lading in case of an accident or rough usage, and to reduce, as far as possible, the number of parts. Therefore, the superstructure was designed with an outside shell composed of a series of 1/8 in. sheets for the side, and 1/4 in. sheets for the ends, in which the posts were pressed integral with the end and side sheets. A U shaped post is pressed into one end of each sheet and is overlapped by the adjacent sheet, which acts as a coverplate for the post and gives to the outside of the car smooth surface. The post part of the sheet is 2¾ ins. deep and 4 ins. wide at the back. The sides of the car are composed of ten sheets each, which have a 2 in. flange, top and bottom, by means of which they are secured to the bulb angle of the side sill and to the 4 in. x 4 in. x 3/8 in. eave angle at the top, the short leg of which extends outward and along the leg upward.

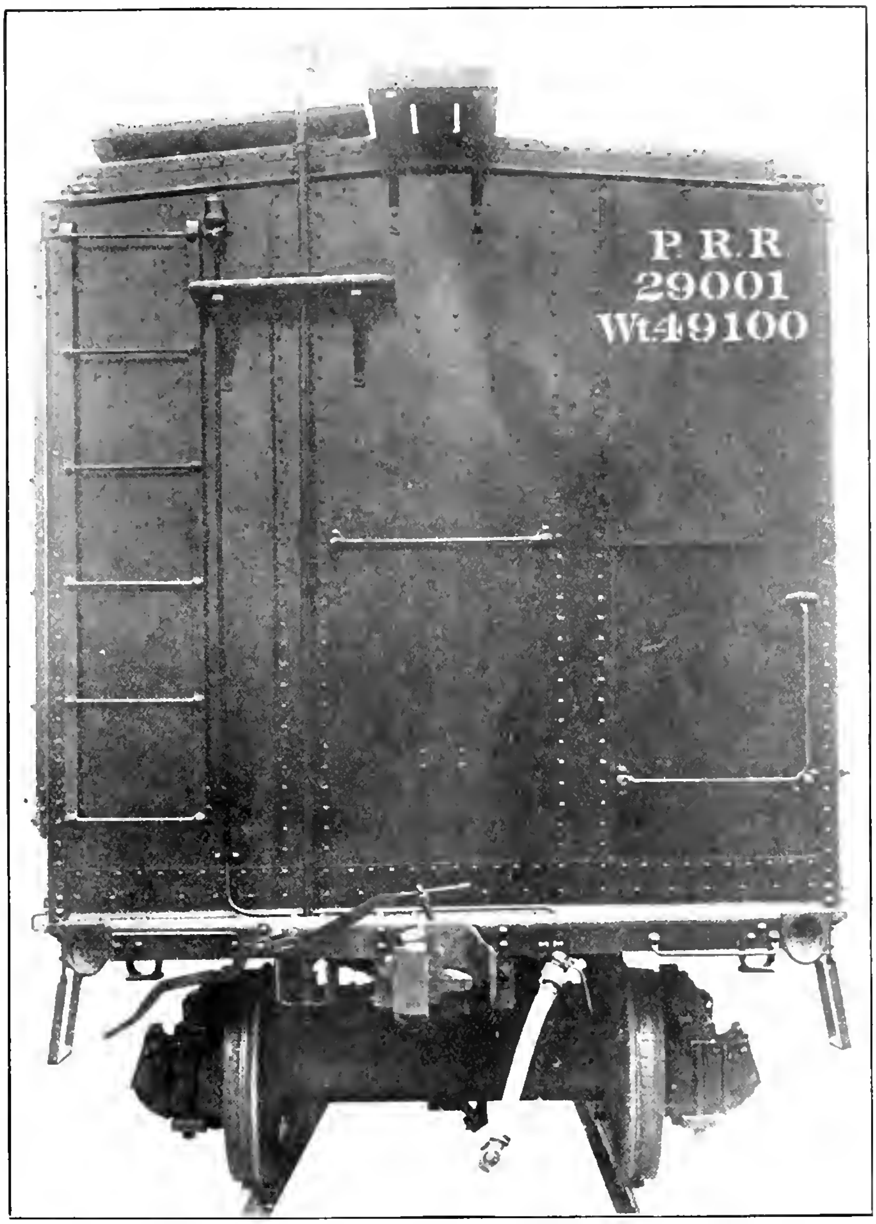
The end construction is similar to that of the sides, each end being composed of three sheets, the two nearest the sides of the car containing the depression which forms the post. Where the central sheet overlaps these, they are depressed 1/4 in., making the outside face perfectly smooth so that it may fit down snugly behind the end sill. The middle sheet has an additional U shape stiffener at the centre 2¾ ins. deep, 9½ ins. wide and 1/4 in. thick, which extends vertically from the end sill to the eave angle.

The side door posts are 4 in. x 3½ in. x 3/8 in. bulb angles, extending from side sill bulb angle to eave angle, being securely riveted to both.

The side and end sheets are tied together by a coverplate, L-shape in section and 1/4 in. thick. This is capped top and bottom by suitable castings, which finish off the corners, and at the same time act as a connection between the side and eave angles and the side and end sills. To the side and end sheets, midway between the posts, vertical nailing strips are secured, to which the lining is nailed in a horizontal position.

The carlins are of the bathtub type, being spaced 3 ft. 9½ ins. apart and resting on the 6 in. vertical leg of the side eave angle and extending downward from the side a sufficient distance to be securely riveted. The 3/32 in. steel roof sheets are continuous across the car, being spot welded to the carlins, which are located in their centre. This allows the butt joint to come midway between carlins, with the exception of the end roof sheets, which, by virtue of the position of the last carlin, must cover one and one-half spaces.

The roof sheets are flanged down on the vertical leg of the side and end eave



END VIEW OF ALL-STEEL FREIGHT BOX CAR FOR THE PENNSYLVANIA.

angles 2½ ins. and are secured to the same by ⅜ in. rivets spaced 4¾ ins. apart. Between the roof sheets and the eave angles are 3/16 in. washers, through which the rivets are driven. This construction allows for a slight ventilation and yet is small enough to keep out any foreign matter which might damage the lading. The roof sheets are fastened together by an outside and inside butt strip. The outside strip is pressed up in the center ⅞ in., which adds to the stiffness of the structure, and is 2½ ins. wide and 3/32 in. thick. The inside strip is 2½ ins. wide and 3/16 in. thick. These strips are continuous across the car and are riveted to the roof sheets with ¼ in. rivets 1½ ins. apart. To insure a perfect water-tight joint, tar paper is placed between the outside butt strip and the roof sheets. The end and side eave conditions are the same, except there is no ventilation at the end. The roof is equipped with an 18½ in. running board, latitudinal extensions and grab irons—all securely fastened to the roof sheets. The 13/16 in. pine inside lining is nailed to the vertical nailing strip conveniently spaced around the sides and ends. The lining extends from within 3 ins. of the floor to a height of 8 ft. 5 ins. Since the posts and nailing strips, which are 2⅝ deep, are all vertical, it will be seen that there is a vertical air space back of the lining, which will allow for ventilation, and also facilitate cleaning, which at times becomes necessary on double-sided cars, due to the lading falling through damaged lining. The application of a triangular grain strip around the edge of the 2⅜ in. tongue and grooved floor, next to the side sheets, allows all foreign matter to work its way out from behind the lining.

A new feature in this car is the manner in which the safety appliances are secured. All grab irons are fastened to castings by means of a slotted hole in the face, which permits the removal of the grab iron bolt, and thus the renewal of the grab irons without disturbing the inside lining. A like provision is made for the side door stop.

DOORS.

The car is equipped with outside hung doors, being supported at the top by hangers at both corners. A 5 in. x 1¾ in. x 5/16 in. angle acts as a top guide rail and weather strip, the short leg being turned down over the face of the door. The door is made of .109 O.H.S., with two vertical Z-shaped edge stiffeners, which are flattened out, top and bottom, supporting the door hanger and door guide castings. The rear stiffener laps over the door post and the front one butts against a 2 in. x 2 in. x ¼ in. angle riveted to the side sheets and projecting slightly beyond the door, thus forming a weather strip, front and back. There are two horizontal U-shaped sections pressed in the end of the top and intermediate door sheets, which overlap the adjacent sheets, forming a box-like stiffener across the door. At the bottom of the door is a 1¾ in. x 1¾ in. x ¼ in. stiffening angle, which runs continuously between vertical stiffeners. The inside of the door is perfectly smooth, all rivets being countersunk. A clearance of 1/16 in. is allowed for door to clear door post. The floor is extended through door opening, flush with the door post, and is supported by the bulb angle of the side sill.

Surge Tank.

The largest tank of the kind known as a surge tank has just been erected by the Kennicott Company, Chicago, Ill., at Altman, N. Y., for the Salmon River Power Company whose works are situated about fifteen miles from Lake Ontario, on Salmon River. The object of the tank is to act as a governor on a pipe line, taking care of back pressure when the load is suddenly taken off, and as a reservoir when the load is suddenly applied.

The following are the dimensions of the principal parts of the tank:

Diameter shell, 50 ft. 0 ins.; height, straight part of shell, 80 ft. 0 ins.; depth of bowl bottom, 25 ft. 0 ins.; total height of tank from bottom of bowl to top of shell, 105 ft. 0 ins.; elevation of bottom above ground, 80 ft. 0 ins.; height of roof, 20 ft. 0 ins.; total height, ground to top of roof, 205 ft. 0 ins.; diameter of bottom riser, 12 ft. 0 ins.; diameter of inside riser, 10 ft. 0 ins. with 15 ft. funnel at top. Number of supporting columns, ten. Number of panels in tower, three. Size of sway bracing, 4 ins. x 1¼ ins. flat. Columns made of two 8 in. x 8 in. x ¾ in. angles, two 6 in. x 6 in. x 1 in. angles, two 24 in. x 15/16 in. plates, one 34 in. x ¾ in. plate in the form of an open box with 3 in. x ½ in. cross lace bars. Base plates and columns each 36 in. x 1 in. x 36 in. anchor bolts, two 2½ ins. round to each column. Grillage under base plates. Each column consists of five 24 in. 100-lb. I-beams and twelve 15 in. 42-lb. I-beams imbedded in concrete. Thickness of bowl bottom plates, ⅞ in. Longitudinal seams in bowl bottom triple riveted butt strap joint; horizontal seams quadruplicate lap. First course of shell 1 in. plate, triple riveted, butt joint. Connection of bowl bottom for first course, two ⅝ in. x 36 in. plates. Thinnest plate in tank ½ in. double riveted, butt strap. Top riser stiffened every four feet by 4 in. x 4 in. x ½ in. angles to take care of difference in elevation of water inside the riser and in tank proper. 12 ft. 0 ins. riser connected to bowl bottom by means of special 12 ft. expansion joint.

The surge tank is connected to the lower end of the pipe line which is to convey the water from the dam to the power house. The pipe line is approximately ninety-five hundred feet long, ranging from eleven feet to twelve feet in diameter.

The surge tank constitutes a hydraulic regulating device for the power plant, being provided on account of the long pipe line. When the power plant is in operation and a sudden demand for more power occurs, necessitating an increased supply of water, the water is temporarily supplied to the turbines largely from the surge tank, while the velocity of the water in the long pipe is increasing to the required degree. On the other hand, when the power load is suddenly thrown off the plant, the surplus water will surge upward and spill over the top of the riser and will be caught and stored in the main bowl of the surge tank, while the velocity of the water in the pipe reduces gradually. The rise of pressure in the pipe line will at the same time be limited to that due to the water rising to the top of the riser.

Mechanical Organizations and Their Work

By DR. ANGUS SINCLAIR

I.—The Traveling Engineer's Association.

At an Executive Committee of the American Railway Master Mechanics' Association held in July, 1913, the suggestion was made that one of the members prepare a paper on the Proceedings of the Minor Railway Mechanical Associations. Dr. Angus Sinclair was requested to prepare such a paper and he submitted the following at the 1914 convention:

For many years of our railway history, two mechanical organizations, viz.: the Master Car Builders' Association and our own, were considered sufficient to investigate, report on and discuss all the subjects relating to mechanical questions that required for settlement the wisdom that results from combined experience. The time however came by increased complication of machinery and other causes, that the Master Car Builders' and the Railway Master Mechanics' Association were unable to cope successfully with all the engineering problems that arose for settlement, and so other organizations came into existence to aid in carrying on the work that had become necessary.

The locomotive engine requires more careful and skillful management than any prime mover that I am acquainted with, so it was not surprising that the first auxiliary mechanical association formed in the United States, worked under the motto, "To improve the locomotive engine service of American railroads." This is the Traveling Engineers' Association which was formed in 1892 and has certainly fulfilled the promise of its motto.

Today the name traveling engineer is hardly applicable to the persons forming that organization, for the published lists of railway officials state that there are over three hundred men with the title of road foreman of engines in the North American continent, while there are less than a dozen listed as traveling engineers. This indicates the change in nomenclature that has come about in twenty-two years, for by far the majority of men holding that position when the Traveling Engineers' Association was organized, were called traveling engineers. The published lists of traveling engineers and road foremen of engines falls far short of the actual number employed, for there are more than 1,000 members of the Traveling Engineers' Association.

The rapid increase of locomotive mechanism and of operating appliances demanded the special instruction of enginemen, a duty the traveling engineers have performed very satisfactorily. A very common practice used to be, to introduce new appliances upon locomotives without instructing the enginemen about their care and operation. If the engineer was of an inquiring and intelligent character, he would find out the proper way to operate the new device; but if he proved careless and indifferent a valuable invention would frequently be condemned as worthless. That has been the fate of many devices brought out to improve the service of the locomotive engines. The supervision of the road foreman of engines has put an end to that waste of useful appliances.

The practice of the Traveling Engineers' Association has been to investigate, report on and discuss subjects that would exercise an educational influence upon all persons connected with locomotive operation.

At the first convention held in Chicago in 1893, reports were read on the following highly practical subjects:

1. The economical use of oil and supplies.
2. Examination of firemen for promotion to engineers and examination of new men for employment as firemen.
3. How can traveling engineers improve the service when engines are double crewed or pooled?
4. What are the best methods for the instruction of men for the safe and practical handling of air brakes in all kinds of service?
5. Testing coal in actual service. What are the easiest and most economical methods?

These reports were thoroughly discussed during six sessions of the convention and occupied 135 pages in the annual report.

In studying particulars of the twenty-one conventions held between the first one and that of last year, I find the question of how to promote economy in the use of fuel and lubricants holds a very conspicuous place. Some of the papers and discussions on these subjects are well worth earnest study by people interested in operating locomotives at the least possible expense.

At the convention held in Chicago last year reports were read on the following subjects:

1. Uniform instructions to enginemen on handling of superheat locomotives.
2. Care of locomotive brake equipment on line of road and at terminals; also methods of locating and reporting defects.
3. Credit due to operating department for power utilization in train movements.
4. Advantage obtained with the brick arch in locomotive service.
5. Scientific train loading. Tonnage rating.
6. What can be done to eliminate black smoke.

The first of these reports was one of the most exhaustive papers ever submitted to a mechanical association and covers the subject so thoroughly that no addition seems necessary to make all the mysteries of superheating plain to every inquirer. That seemed self-evident, but its reading was supplemented by a most masterly discussion which covers 44 pages and was participated in by 23 speakers. In all my experience attending mechanical conventions I have never heard a report as thoroughly discussed. That report and discussion has certainly done much to disseminate accurate information concerning the operation of superheat locomotives.

There were five more subjects which brought forth good reports and discussions above the average. The report on that ancient subject "Smoke Prevention," was excellent, having been prepared by Martin Whelan, who knows as much about the smoke nuisance as any man connected with railway operation. An active discussion followed the reading of Mr. Whelan's report, which indicated that the members are keenly interested in the subject. The conclusion arrived at is one that was arrived at many years ago which is: that a careful engine crew is the best influence in locomotive service for the elimination of black smoke.

Rails "Creeping."

A German engineering authority states that: Formerly it was thought that creeping was caused partly by the friction between rail and wheel and partly by that between rail and sleeper; but the general opinion now is that creeping is caused chiefly by the percussive action of the wheels at the joints when the wheels leave the trailing rail end and strike the facing rail end. At the same time it is a remarkable circumstance that German philosophers when equipped with a double action microscope discover many things that are not so.

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Locomotive Counterbalancing.

Among the subjects selected for investigation and reports to be made to the next convention of the American Railway Master Mechanics' Association is that of "Locomotive Counterbalancing." "This subject has been recommended for further consideration, for the reason that with the increasing static weights on driving wheels, the question of dynamic augment due to counterbalancing is becoming exceedingly important, and the necessity for an improvement in the direction of a reduction of the reciprocating weight which will reduce this augment assumes at the present time an importance which it did not possess in the old days, when the principal consideration was that of securing satisfactory fore and aft balance of the locomotive."

So says the committee which has recommended this subject for renewed investigation.

A locomotive running at high speed with the reciprocating and revolving parts unbalanced makes such jerking and oscillating progress, that fast trains had scarcely begun to be operated when the engineering world was called upon to devise a remedy. The response was immediate and widespread, but the problem was so difficult of solution, and there was so much conflict of opinion among the doctors, that the problem has never been satisfactorily solved, hence the demand that the Railway Master Mechanics' Association wrestle with it once again.

Every time that a new heavy locomotive is designed it gets heavier than its predecessors. Some additional strength is given to the framing, the boiler is made an inch or two larger and of heavier steel, for higher pressures, and so on, the weight and strength of the engine is constantly being increased, and is therefore more and more capable of absorbing by its increased mass and strength a greater proportion of the disturbances caused by the reciprocating weight without detriment to itself; but the heavier engine has to run over the same old worn rails, over the same old bridges and trestles designed years ago for lighter rolling stock, and in many cases cannot be strengthened to withstand increase of vertical blows due to the full balancing of heavy reciprocating parts and higher speeds.

The calculations and records of experiments made to demonstrate the proper methods for counterbalancing the disturbing action of the reciprocating parts of locomotives would form a library. The first proposal ever made to overcome the unsteady motion of locomotives due to their being unbalanced, by the application of counterweights to the driving wheels, was advanced by George Heaton in 1831. In 1834 J. G. Bodmer patented the application of two pistons of the same stroke to work in each cylinder, operating upon a double crank on the axle in opposite directions; the avowed object being to make the disturbing act of one piston counterbalance that of the other and then obtain perfect equilibrium. In 1836 Weallens brought out a four cylinder engine which was the prototype of the well known Shaw locomotive which was for years persistently urged upon our railway companies.

Mr. Fernihough was the first to propose and carry out the balancing of the reciprocating parts of a locomotive by counterbalancing weights applied to the wheels. This was done in 1845 on a number of locomotives. In 1847, George Heaton proposed to use a double crank, and to have a connecting rod attached to the outer crank pin, which connecting rod was to give motion to weights sliding on guide bars that would thus move in opposite directions to that of the piston and appendages, neutralizing the disturbing action of these. In 1847, Mr. Haswell brought out an engine similar to the Weallens engine of 1836, and almost exactly like the recent Shaw and Ball locomotives, which engine was in regular service on the Austrian State railroads from 1847 to 1873. Up to 1847, while many locomotive designers understood that the reciprocating action of the pistons, rods, and cross heads, was the cause of the disturbances, the nature of their action was not clearly understood, but in 1848, Mr. Nollau, of the Holstein Railways, in Germany, analyzed the subject carefully and correctly, then made some rough experiments in applying what he calculated should be the correct counterbalance weights to some of his locomotives, and satisfied himself that he was correct in his assumption. In 1848, Mr. LeChatelier in the work shops of the Orleans Railway in France, suspended a locomotive by heavy ropes so that the wheels were entirely clear of the rails; a pencil on the end of a light arm was attached to the front bumper beam at one corner, under which pencil, sheets or cards could be held. When the engine was set in motion, the pencil would describe a diagram on the card which would give the exact amount of lateral and fore and aft disturbance. Experiments were made with no counterweights at all, and with different amounts ranging from enough to balance the revolving weights only, up to more than enough to fully counterbalance the whole of the reciprocating weights; these were repeated for speeds varying from ten to thirty-five miles per hour, and it was found that, without any counterweights at all in the wheels, the movement was about three-eighths of an inch laterally and fore and aft, when balance weights were applied sufficient to counterbalance all the revolving weights, and forty-two per cent. of the reciprocating weights, the movement was reduced to 3/32 of an inch, and when the weight was increased so as to provide counterbalance for all the reciprocating parts, the lateral and fore and aft movement ceased, but the vertical, or up and down movement, was increased materially. These experiments were repeated with a six wheel coupled freight engine by M. LeChatelier with precisely similar results. They were again repeated on the Northern Railway of France, with a six wheel coupled engine. Similar tests have been made at different times and places in England with a variety of engines, and in this country such

tests have been made by the Pennsylvania Railroad, and by the Chicago, Burlington & Quincy, with actual locomotives, also by Professor Lanza, of the Boston Institute of Technology, with models. The results obtained from all these experiments confirm the deductions made by LeChatelier, a very full description of whose experiments is published in D. K. Clark's Railway Machinery.

That brief history of counterbalancing was collected by Mr. R. P. C. Sanderson in 1894 and used in a paper on counterbalancing which he submitted to the Southern & Southwestern Railway Club. Besides these facts Mr. Sanderson collected a great deal of other valuable information about counterbalancing. Ignoring certain rules given for counterbalancing by users of inside connected engines, he gave particulars of seventeen different methods of counterbalancing which certainly will give the new committee much matter to consider. In 1893 Mr. R. A. Parke read a paper at the New York Railroad Club on counterbalancing which is a masterly exposition of the subject from a mathematical standpoint.

The threshing out of counterbalancing to meet conditions of modern locomotive designing will supply rich food for thought to the people who are now striving to build locomotives that will run smoothly without imparting destructive shocks to rails and bridges.

The General Foremen's Convention.

July is not a good month to select for holding conventions or other business gatherings in Chicago; but there the tenth annual convention of the International Railway General Foremen's Association assembled on July 14 and kept up sessions for four days. To meet in convention in Chicago during the roasting month of July implies self-denial on the part of the members, but to keep up the meetings for four days, and to have a full hall every day, says much for the endurance and enterprise of the members. Yet they did that and performed a volume of business that was highly creditable to the members and cannot fail to promote the efficiency of locomotive repairing.

Four committee reports and one personal paper occupied the time of the convention, but the reports were wonderfully exhaustive papers and were discussed with extraordinary thoroughness. It seemed that every member was familiar with every subject introduced and desired to give full information from his own standpoint. This brought out a volume of facts and views of a character thoroughly practical and valuable.

The tenth annual convention of the International Railway General Foremen's Association was the largest and most successful in the history of the organization and manifested decided progress. The president and officers of the association have good reason to be proud of the success achieved.

Alluring Conventions to California.

The people who are promoting the Panama-Pacific Exhibition in San Francisco next year, are making strenuous efforts to induce the various railway and other associations to hold their annual conventions in San Francisco at the time the Exposition is on show. A visit to California forms a pleasant recreation for people who have time and money to make the trip at their leisure, but for the members of technical associations to undertake the long journey ostensibly to visit an exhibition we consider a particularly foolish wasting of time, money and energy.

Taking the location of the two principal railway mechanical associations, the Master Car Builders' Association has 189 members with headquarters west of the Missouri river and 623 members dwelling east of that stream. The Railway Master Mechanics' Association has 220 members west of the Missouri river and 702 located east. It would make a particularly long and tedious journey for these thirteen hundred odd members and their personal friends to make for the sake of attending a display which few of them could spare time to examine thoroughly.

If we take Pittsburgh as the center of the eastern members' homes, in going to San Francisco direct they would have to travel over three thousand miles, keeping them in the cars more than three days and three nights. Most of the members are reaching towards old age, a time of life when a dreary, protracted rail journey has discomforts not to be readily endured.

The exhibition will no doubt be attractive and interesting to the person of leisure; but it is doubtful if the railway mechanical men, mechanical officials, would see more devices useful for their repairing operations, than they have the opportunity to examine annually at the conventions they have attended for years.

For the mechanical conventions to meet in California would be equivalent to giving the railway supply houses the intimation that their annual exhibition of railway appliances is no longer desired; but it would be utterly impracticable to transport to California the devices shown of late years at Atlantic City and other watering places. The railway mechanical organizations were formed to improve railway rolling stock by mutual efforts, resulting from combined knowledge and skill. We do not believe that their associations, or the railway companies they represent, would derive any benefit from meeting at a place that would involve nearly a week of railway traveling.

Pittsburgh Promises Revival of Business.

When trade depression prevails a pleasant tendency of human nature is to look for and prophecy of better times. We are hearing these gratifying predictions ringing in our ears every day now and we hope they are going to prove true.

Pittsburgh, with its great manufacturing interests, may be taken as a pulse indicating the condition of the nation's industrial health. There seems to be no doubt that the beat of that pulse is every day becoming steadier and stronger. The railroad rate question that suspended purchasing of supplies is becoming ignored and Pittsburgh is returning to its old-time prosperity. A recent dispatch from Pittsburgh reads:

"All branches of trade are feeling the stimulus of the return of normal conditions. The Pittsburgh pay roll, measured on the unexampled standard of $1,000,000 a day, again is making itself felt in the home commercial mart. This unrivaled asset in Pittsburgh business—and especially in guaranteeing the stability of the community's mercantile trade—is growing greater.

"Reports in the iron and steel industry for July in the Pittsburgh district show an increase over June of 10 per cent. For August the outlook is still better. In the fall many new industries located here. All told, they will give year-round employment to 6,000 skilled mechanics of the highest wage-earning capacity. This will give at least 4,000 additional families, who will augment the receipts of Pittsburgh merchants."

Engineer Who Deserves Sympathy.

One of the most outrageous actions that we have noticed in some time was that of a grand jury in Iowa which returned an indictment against Engineer William J. Brady, who was running the engine of a train that ran into a wagon load of people returning from a Fourth of July picnic, killing Mr. and Mrs. Schnider. The party was said to be very hilarious and the accident turned their joy into woe. The track was visible a long way from the crossing, but the driver of the wagon made a miscalculation as to the speed of the approaching train and the wagon was struck near the middle.

It would be edifying to find out on what grounds the grand jury put the blame upon the engineer. Of all persons in such accidents the engineer is deserving of sympathy rather than blame. He is responsible neither for the condition of the tracks, the crossing of roads at grade, nor the negligence and careless-

ness of people driving in front of approaching trains. He has a schedule to make, prescribed by the company that employs him and demanded by its patrons. He must take for granted that his way is open and the tracks that he is to traverse are clear. He has nothing to do with the making of operating rules any further than as they apply to his personal rights, nor is he responsible for the lack of rules for the regulation of the public using the highways of the country through which he is passing.

The question of responsibility for tragedies at railway road crossings is one difficult to fix. The railroads are given the right to cross roads and streets with their tracks and we believe generally comply with such requirements as are made of them for warning the public of approaching locomotives. These warnings are, however, useless unless the public observes them. The frequency of tragedies at these grade crossings would seem to demand that something be exacted of the users of roads and streets. It is much easier to stop a wagon, buggy, carriage or automobile than a locomotive, so that fairness would indicate that the public be required to know before crossing a railroad track that a locomotive is not about to pass at the same moment. The railroad posts its signs at most crossings: "Look out for trains!" which ought to remind drivers of passing vehicles to be sure that there is no train in sight.

The time will come when grade crossings will be abolished, but until then it is simply outrageous to saddle the blame of accidents upon the railroad companies or their employees. The verdict we are discussing was the result of that prejudice against railroads so common among rural rustics.

Against the Fire Rake.

The writer who learned locomotive firing where fuel saving methods were very rigidly enjoined never saw a fire rake until he went running a locomotive in the United States, and he always considered the rake an implement of torture to a decent fire. His views in this respect seem to be shared by Mr. W. C. Hayes, superintendent of locomotive operation of the Erie Railroad, who recently published the following remarks on the subject:

In my own observations, and in reports submitted by the supervisors of locomotive operation and road foremen of engines, it has been noticed that there has been an excessive use of the fire rake by firemen, in some instances the rake having been used as many as twenty and thirty times in a short distance.

The use of the rake is not only a violation of instructions, but is objectionable from the standpoint of economy, the production of black smoke, as well as the imposition of at least 40 per cent. additional labor upon the fireman. The use of the rake is entirely unnecessary. There is no coal being furnished the Erie Railroad Company for locomotive fuel purposes than cannot be better fired without the use of the rake than with it. If instructions are strictly adhered to, and the coal is fired as per Chart 4919-B, firemen can entirely eliminate the use of the rake.

From the standpoint of economy, there is much to be said; the use of the rake not only makes the fire burn with less heat, but the combustion of gases is poorer, free air admission is prevented, more coal is used, and therefore, necessarily, more ashes and clinkers are formed. It can, therefore, easily be seen that the use of the rake is not beneficial to the company, and at the same time is detrimental to the fireman.

A "good" fireman never uses a rake. It is only the green fireman or the poor fireman that has to resort to this unnecessary habit, in order to maintain maximum and uniform steam pressure. Do you consider yourself in either of the latter classes? If so, you are working 40 per cent. harder than is required. Do you think it wise to continue doing so?

If a fireman has been grounded in wrong firing methods and resorts to the use of the rake to get proper combustion, it will be to his own interest, as well as to the company's advantage, to immediately discontinue this practice.

By following the advice of his supervising officers, firing as per Chart 4919-B and other instructions issued on this subject, and co-operating with the engineer in all respects, he will not only make his work easier and save money to his employer, but he will eventually become a better all around "good" fireman.

Cylinder Condensation and Superheaters.

There are certain expressions frequently occurring in engineering papers that readers are supposed to understand without any explanation being given, but many of them are vaguely comprehended, while others are misunderstood or distrusted. Since superheat locomotives began to come into use, the term superheat is repeated very frequently, but the average railway man has no clear idea of what superheat means. The same may be said of the expression "saturated steam," which is frequently heard repeated.

When water is boiled till steam is formed, the resulting vapor is saturated steam, which is called "saturated" so long as it remains in contact with the water. Saturated steam is always at what is called the dew point, ready to return to water when the least abstraction of heat is made from it. In the operation of all steam engines the tendency of saturated steam to revert to water, which loses its motive power force, is a source of serious heat losses and may amount to 25 per cent. or more of the heat originally used in raising the steam.

This action, known as cylinder condensation, has been familiar to investigating engineers for many years, and many experiments have been tried to reduce the heat losses, cylinder jacketing having been tried as long ago as James Watt's time. When steam is admitted to the cylinder, the latter is comparatively cold and at once acts as a condenser on the entering steam. This condensing action continues during the whole period of admission and expansion. When release occurs and the pressure in the cylinder is materially reduced, there is a tendency of the water or water vapor to flash back into steam, increasing the back pressure, thereby magnifying the heat losses.

Many practical railway men have been inclined to regard this theory of cylinder condensation as idle vaporing, but it has been so plainly demonstrated to be true that all intelligent engineers are now convinced of its truth.

Superheated steam, on the other hand, is steam containing more heat than steam holds in the presence of the water from which it was evaporated. By the use of the proper boiler arrangements for applying heat to steam after it has been separated from the water, any degree of superheat may be secured. In practical working, superheated steam holds so much extra heat that when it enters the cylinders there is no condensation and the steam continues to be dry during all the events of the stroke. The serious heat losses due to cylinder condensation are thereby prevented.

No improvement effected on the steam engine since the separate condenser was introduced has proved so valuable a heat saver as superheated steam, and it is something of a mystery that the invention was not made practical earlier. In studying engineering literature, a reader occasionally meets with expressions of belief that the use of superheated steam would remedy the evils of cylinder condensation, and various experiments were made from time to time with superheated steam, but decided success seemed always to be prevented by small obstacles, such as difficulty with cylinder lubrication, packing, and so on. The experimenters in this field of research lacked faith in the theories they worked upon and failed through lack of proper perseverance.

The practice of superheating steam is by no means new, for it had been tried, abandoned and tried again, long before any of the present generation of engineers was born. That erratic inventor Richard Trevithick, designer of the first locomotive that ever ran on rails, was the first engineer to experiment with superheated steam. That was in 1828. A heat saving of about 33 per cent. was claimed

for that invention, a result which ought to have made all users of steam engines favorable to superheaters, if they had not been blindly opposed to innovations. Many insulated experiments were made with superheaters between 1830 and 1896, and claims for great savings were always made, but for various reasons the superheating appliances were quickly abandoned. In 1873 the writer made several trips in the engine room of a steamer that had a superheater in the uptake. When fairly tried, this superheater saved about ten per cent. of fuel, but it was disliked by the chief and second engineers because it increased their responsibilities, and was abandoned.

An impression long prevailed among engineers that a locomotive was the last kind of engine on which to experiment with a superheater; but about 1895 Dr. Wilhelm Schmidt, a German scientist, began experimenting with superheaters on locomotives, employing an unusually high degree of heat. He displayed perfect confidence in his knowledge and judgment with the result that his system of superheating became a decided success. All the engineering world are aware that the Schmidt superheater worked so well that within five years after the first one was applied, the superheater became practically established as a part of nearly all locomotives on the Prussian state railways. From that time on the superheater jumped into popularity, till now it has become a recognized part of all first-class locomotives in every part of the world. It has vanquished the evils of cylinder condensation.

Encourage the Tool Foremen.

In his inaugural address Mr. W. W. Scott, president of the International Railway General Foremen's Association, urged the members of the association to maintain the closest relationship possible with the Tool Foremen's Association, and suggested that a plan might be carried out so that both associations meet in the same week and at the same place. Both organizations, he felt sure, would profit by such a plan if carried out.

We consider the comments made by Mr. Scott concerning the Tool Foremen's Association highly commendable, and feel that the plan of getting closer together would promote the prosperity of both associations. The International Railway General Foremen's Association has now reached sound footing after efforts have been made to abolish the organization by promoting the members to organizations of a more pretentious character, but the Tool Foremen have not been particularly prosperous, and any movement calculated to increase their membership and to make the work they are doing better appreciated would redound to the strength of the association and increase the value of the Tool Foremen's work.

Objects of Discipline.

What is the object of discipline? Clearly to improve the service by the improvement of the men who form its units. Are those most immediately subjected to discipline improved by the system in operation for their control? We have a higher grade of men than we had thirty years ago, but the question arises, has the discipline practiced tended to effect improvement or have they become better in spite of it? The man who early learns that harshness is less powerful than kindness in commanding the services of another, will best succeed by those under his control. Chastisement is too often regarded as proper discipline. Too many men in charge of others seem of the opinion that the only way a person can be taught is through suffering. Discipline should always have an educational influence, but the old proverb that "lickin' and learnin' go together" should have no place in modern instruction.

A man or a boy enters the shops of a great railroad and becomes at once a part of a great machine. The old way still too much in vogue is that no one notes his coming or going. Nobody notes that his work is good, that he is sober and industrious though quiet and retiring. Some day he ventures to suggest to his foreman an idea which he thinks is good. He is told to attend to his work and not concern himself with something beyond his province. Naturally diffident, he is easily crowded out of sight where he remains. He becomes indifferent and mechanical, takes no thought to surrounding conditions, but plods on because he must, working for the whistle and the pay car. More is needed from a good foreman than the ability to push work. He ought to understand human nature.

What Railway Companies Spend on Operating.

The Bureau of Railway Economics devotes itself to the arduous task of telling the truth concerning railway receipts and expenditures. A recent compilation says that during the fiscal years 1908 to 1913 inclusive the steam railways of the United States of Class I invested in their roads and equipment cash to the amount of $4,010,385,303. Railways of Class I, so designated by the Interstate Commerce Commission, are those with annual operating revenues of over $1,000,000. They include about 90 per cent. of the mileage, receive more than 96 per cent. of the revenues, and handle more than 98 per cent. of the traffic.

This cash investment of the operating railways of this class of the eastern district during the six years was greater than the amount of capital securities issued by them during this period, and was 19.9 per cent. of the aggregate of their capital securities outstanding June 30, 1913; of the railways of the same class of the southern district it was 21.1 per cent., and of the railways of the same class of the western district it was 23.2 per cent. of the aggregate of their capital securities outstanding June 30, 1913. That is, the cash actually expended by these railways during the last six years upon their properties used in transportation amounts to more than one-fifth of their total capitalization at the close of the last fiscal year. This is at the rate of $668,397,551 per year.

Slaughter of Trespassers.

There were 230 laws relating to railway operation placed upon statute books last year, but not one of them aims at effectually checking trespassing upon railway property. Sixty-five bills were introduced to prohibit tresspassing on railway property in the United States, but none of them became laws.

Yet, on the law of average, fourteen people were killed trespassing on American railways today, and the same number will be killed tomorrow and every day during the year. Of all the 10,446 persons killed on American railways in 1912, 5,449, or one-half, were trespassers, therefore law-breakers, although the weak laws against this offense are a dead letter.

It is hopeless to expect the passing of laws that would punish trespassers on railway property because the rustics whose votes are supreme in the making of state laws, insist on enjoying the privilege of walking as they please on the railway right of way.

Think of it, ye who advocate laws for the prevention of cruelty to animals: Sixty-five laws to prevent trespassing on railways and none passed.

Familiarity With Danger.

It takes years of experience and sometimes the emphasis of serious accidents to make young men realize that danger always lurks when machines are in operation. Familiarity with danger breeds contempt which has often been paid for by the loss of members of the body. The person who ever keeps in mind that no moving machine can be safely trifled with is the one that escapes accidents.

The increasing good sense of our day and generation has banished practices from machine shops that were very common in the "good old times" and led to many painful accidents. We youngsters of past generations used to admire the man who indulged in reckless practices with machines and tools. Nowadays we estimate the reckless man at his true worth and tell the foreman that we would rather work with some one else. That means living up to the injunction "safety first."

General Foremen's Department

General Foremen's Convention.

"The International Railway General Foremen's Association met in convention in the Sherman Hotel, Chicago, on July 14 last. The convention was presided over by President W. W. Scott, who proved himself a clear-headed and energetic official. After prayer and an address of welcome, delivered by Mr. Leon Hornstein, one of the city magistrates, President Scott delivered the inaugural address, in which among other sensible things he said:

President Scott's Address.

"The Railway General Foremen's Association is a progressive organization as evinced by its growth and accomplishments during the past nine years of its existence, and we have brighter hopes for its future success. The years 1913-1914 will not be remembered as prosperous years for the railroads, this condition being brought about by the influence of legislation, affecting railroads in general and the mechanical department in particular. Recent events have brought rather prominently to public view the question of efficiency and economy in railroad operation. As railway officials, efficiency and economy have been our constant watchwords. I am sure, however, that with almost unequalled crop prospects and some assurance that the many vexing political questions will be settled, the railroads for the next few months will be so busy that their chief concern will be their ability to furnish equipment necessary for the increased business.

"Land values have multiplied, manufacturers have developed and grown prosperous, trade has been stimulated and it is not an overdrawn statement to say that the greatest single factor in our material prosperity has been transportation. Nor is there any product of capitalized human effort so cheap today as transportation, when cost of production is considered.

"Publicity has not, until recent years, entered very largely in railway operations, and the public has been often led astray in not being correctly informed as to the methods of efficiency and economy practiced by the railways. Every published statement reflecting credit on the railways, whether relating to their good intentions or their able management, strengthens them in public esteem and tends to promote a wise and judicious solution to the problems of government regulations. There are none of us who wish to evade discussion of our efficiency.

"As far as the mechanical department is concerned, our efforts have not been sufficiently brought to the light of public recognition. We have been satisfied with the appreciation expressed by those best in a position to judge. We have spent the best part of our lives in acquiring knowledge of things mechanical, from any quarter whatsoever which might be useful in promoting efficiency and economy.

ANNUAL DINNER OF THE INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.

"What is the purpose and significance of this convention? Here the standard of efficiency and economy in the performance of every function incident to the manufacture and maintenance of the locomotive has been advanced by comparison of experience. It is here we have our suggestions to offer for the betterment of our power. It is here where our companies reap the benefit of yours and my experience, thoughts and labor.

"It is particularly pleasing to me in finding so many ladies present. It is hoped the sunshine of their presence will not drive too many of our members in the shade. The ladies' auxiliary which was organized in 1913 is a valuable ad-

junct to the General Foremen's Association, and I earnestly hope they will be successful in enlisting the efforts of all members to their cause.

"Would further recommend that the closest relationship be sought between the General Foremen and Tool Foremen's Association and believe a plan could be worked out whereby the two organizations would meet during the same week. Both organizations, I am sure, would profit by this plan if adopted.

"It is also a pleasing duty to report that none of our members have passed to the Great Beyond since the 1913 convention.

"I wish to express my sincere appreciation of the co-operation and assistance of the officials of the association and committees who have prepared reports, and to thank them for their efforts in keeping to a high standard the General Foremen's Association. To our secretary and treasurer, Mr. Wm. Hall, the association is under great obligations. He has made history handling the business of this organization. Papers were all in, printed and distributed thirty days before this convention was called to order. His slogan is 'Do it now,' and I add to it: 'He did it well.'

"Much of the success enjoyed by the General Foremen's Association is due to the widespread publicity given to us in the columns of the mechanical trade journals. Not only in the way of liberal space allotted to us as an organization, but publishers and editors have made extraordinary personal efforts to build up the membership and interest of the association. And in behalf of the General Foremen's Association, gentlemen of the press, I thank you."

REPORT NO. 1—ENGINE HOUSE EFFICIENCY.

This most exhaustive report was prepared by Mr. W. W. Smith, and represents an enormous amount of valuable work most carefully compiled. We have been ambitious to print the whole of this report for the benefit of our shop readers, but our space is not large enough.

The report contains 54 separate topics and begins: In the report on Engine House Efficiency, presented last year, the different phases of the subject were treated in a general way. The subject was continued so that new material could be added to stimulate discussion. The relation that good locomotive performance bears to railway earnings is now generally recognized, and hence new methods are constantly being devised to secure safety and efficiency of service. Strictly speaking, some of the items mentioned in this report do not come under the head of engine house efficiency, but they have been included because of their important relation to the subject. The names of the various subjects then follow.

They begin: "Engine Mileage," "Pooled or Assigned Power," "Terminal Delay," "Engine Delays," "Engine Failures," "Mileage Between Shoppings," "Relation of Shops and Engine House," etc.

The subjects were taken up one by one by the members and discussed in the thorough manner already described. We have not the space required to give more particulars at present, but we hope to deal with them from time to time.

The remaining reports deal with "Valves, Cylinders, Cross Heads, Piston and Guides," by Mr. J. T. Mullin; "The Practices and Methods of Maintenance and Repairs to the Air Brake and Its Appurtenances," by Mr. Chas. M. Newman. "Autogenous Welding," by Mr. C. I. Dickert, another very exhaustive report profusely illustrated. Mr. Dickert was ably assisted by Messrs. R. B. Van Wormer, C. M. Newman, A. A. Masters, F. R. Miller and Wm. Hall.

The conclusion of the business was a paper on "Taylor System," contributed by Mr. W. W. Scott.

OFFICERS OF GENERAL FOREMEN'S ASSOCIATION.

The men elected to carry on the business of the Railway General Foremen's Association for the current year are: President, W. W. Scott, D. L. & W. Railroad, Buffalo, N. Y.; first vice-president, L. A. North, Illinois Central Railroad, Chicago, Ill.; second vice-president, Walter Smith, C. & N. W. Railway, Chicago, Ill.; third vice-president, W. T. Gale, C. & N. W. Railway, Chicago, Ill.; fourth vice-president, G. W. Ryer, N. C. & St. L., Nashville, Tenn.; secretary-treasurer, Wm. Hall, C. & N. W. Railway, Winona, Minn.; executive committee: C. L. Dickert, C. of Ga. Railway, Macon, Ga.; J. S. Sheafe, Staten Island Lines; Geo. H. Logan, C. & N. W. Railway; C. M. Newman, Rocky Mountain Roalroad; E. E. Greish, Pennsylvania Railroad.

Exhibits at General Foremen's Convention.

The following railway supply firms maintained exhibits and representation at the convention of the International Railway General Foremen's Association held at the Hotel Sherman, in Chicago, July 14, 15, 16 and 17:

National Machinery Co., Tiffin, Ohio, bolt threading machinery; Jenkins Brothers, New York, valves; Carborundum Co., Niagara Falls, N. Y., abrasives; Nathan Manufacturing Co., New York, lubricators and injectors; Keystone Lubricating Co., Philadelphia, driving box cellar; Barco Brass & Joint Co., Chicago, flexible couplings; National Boiler Washing Co., Chicago, boiler washing systems; Duff Manufacturing Co., Pittsburgh, jacks; Crucible Steel Co. of America, Pittsburgh, tool steels; U. S. Metallic Packing Co., Philadelphia, piston rod and valve stem packings; Garlock Packing Co., Palmyra, N. Y., packings and gaskets, Ingersoll-Rand Co., New York, pneumatic tools; American Steel Foundries, Chicago, couplers and special castings; Pyle National Electric Headlight Co., Chicago, electric headlights; McCord & Co., Chicago, system of forced feed lubrication; Pilliod Co., Swanton, Ohio, Baker valve gear; Lutz-Webster Engineering Co., Philadelphia, percussion tools; Celfor Tool Co., Buchanan, Mich., high speed tools; The M. C. B. Co., Chicago, agents for the Wiltbonco Mfg. Co., Boston, Mass.; Grip Nut Co., Chicago, lock nuts; Okadee Co., Chicago, blow-off valves, tender connections; Harry Vissering, Chicago, locomotive sanders and other specialties; Ashton Valve Co., Boston, valves and gages; Colonial Steel Co., Pittsburgh, tool steels; Racine Tool & Machine Co., Racine, Wis., hack saws; Ohio Injector Co., Chicago, injectors; Crerar-Adams Co., Chicago, portable electric drills; Joyce-Cridland Co., Chicago, jacks; Hunt-Spiller Mfg. Corporation, Boston, Mass., valve and cylinder bushings and rings; Independent Pneumatic Tool Co., Chicago, pneumatic hammers and drills; O'Malley-Beare Valve Co., Chicago, multiple valves; Edna Brass Mfg. Co., Cincinnati, Ohio, injectors; Locomotive Superheater Co., New York, superheater apparatus; Rich Tool Co., Chicago, drills and reamers; Herbert C. Williamson, Chicago, metal cutting band saws; Greene-Tweed Co., New York, palmetto packings; Edgar Allen Steel Co., Chicago and New York, alloy-steels; Strong Carlisle & Hammond Co., Cleveland, Ohio, machine set screws, journal and cross-head linings; Goldschmidt Thermit Co., New York, thermit welding compounds and apparatus; Detroit Lubricator Co., sight feed and flange lubricators; Manning, Maxwell & Moore, Chicago and New York, locomotive specialties; Ben Lowenthal, Chicago, the Wilhelm automatic safety coupler; The Chicago Pneumatic Tool Co., Chicago, air compressors and air driven tools.

The Westinghouse Strike Over.

The senseless strike that prevailed at the Westinghouse works at East Pittsburgh for several weeks without any intelligible cause was called off by the workmen on July 9. The strikers' pickets that kept many of the people from going to work were withdrawn and a rush into the shops was at once made by the operatives. One week later found almost all of the workers back in their places and very soon afterwards the works were running on full time. A woman agitator who learned her business of objecting in the potato fields of the Emerald Isle took the lead in drawing that great host of workers into the wilderness of idleness, but the good sense of the workmen found a way out of it, and the feeling between employers and employees was never better than it is today.

Elements of Physical Science

By JAMES KENNEDY

XX. WHEELWORK.

Whatever form machines may have they are merely combinations of the six simple mechanical powers already described. The main object in combining them are to gain power or direction to the motion so that the machinery will do the work required.

It may be readily noted that the wheel enters more largely into the construction of machinery than any other of the mechanical powers, and a combination of a number of wheels is called a train. When there are only two wheels, the one that imparts the motion is known as the driver, while the one that receives the motion is called the follower. The methods of transmitting motion from one wheel to another are of three kinds, either by the friction of their outer rims, or by a band, or by teeth. Wheels may be moved by friction on their smooth rims, but they are generally roughened so that friction prevents the moving wheel from slipping over the one at rest, and motion is imparted to the one at rest. Wheels connected in this way work with little noise but are almost useless where there is much resistance to be overcome, and hence they are not much used.

A band passing around the circumference of two wheels is an excellent method, where convenient, of transmitting motion. These wrapping connections or endless bands or belts must be stretched so tight that the friction on the wheels must be greater than the amount of resistance to be overcome. The flexible band has several advantages, among them being the pliability to move the two wheels in the same direction, or in opposite directions, as may be desired, the latter movement being accomplished by crossing the band between the two wheels. The motion imparted by a connector band has the advantage also of being almost free from inequalities, the stretching of the band readily adapting itself to any sudden variations in motion.

When wheels are moved by teeth on the circumference of each, the smaller toothed wheel is called a pinion, and the teeth are called leaves, and two or more wheels so connected are called a gearing, and are said to be in gear when they are arrayed so that the teeth work smoothly in each other. It may be noted, that, as in all mechanical combinations, what is gained in speed by the use of wheels imparting motion is lost in power, and so power is increased by the reduction of speed. The element of friction consumes some of the power, ten per cent. generally being allowed as the loss incurred in large machines. The Shay geared locomotive is an excellent illustration of the gain in power by the use of teethed wheels, for while the speed is reduced the tractive effort is correspondingly increased.

Of toothed wheels there are three kinds in general use—spur wheels, crown wheels and bevel wheels. The teeth in spur wheels have their teeth perpendicular to their axes, and are either made in one piece with the rim or are fitted into the rim, and in the latter case are called cogs. Crown wheels, on the other hand, have their teeth parallel to their axes, and while running vertically communicate a horizontal motion to a wheel with which it is in gearing.

Bevel wheels are wheels whose teeth form any other angle with their axles than a right angle. Circular motion may readily be connected into rectilinear motion by the use of the rack and pinion, the revolving pinion moving the rack as the teeth engage each other.

Cranks are much used in machinery for converting rectilinear motion into circular or circular into rectilinear. The general form of the crank is by bending the axle. It will be readily noted that the point at which the reciprocating rod stands at right angles to the axle is a dead point where the crank loses its power for an instant, and it must be carried past this point by acquired momentum or other force.

Fly wheels are used for regulating the motion or momentum of machinery. It appears in various forms, but generally consists of a heavy iron hoop with bars meeting in the center. It is set in motion by the machinery and its momentum prevents the motion of the machinery from varying to any great extent.

XXI. THE MECHANICAL POWERS.

All mechanical contrivances are merely variations of six simple mechanical powers known as the lever, the wheel and axle, the pulley, the inclined plane, the wedge, and the screw.

A lever is an inflexible bar, capable of being moved about a fixed point, called the fulcrum. What is known as the law of the lever is the fact that intensity of force is gained, and time is lost, in proportion as the distance between the power and the fulcrum exceeds the distance between the weight and the fulcrum. It was said of Archimedes that when he saw the immense power that could be exerted with the lever, he declared that with a place to stand on he could move the earth itself.

The wheel and axle is a revolving lever. It will be noted that one application of the lever cannot move a body any great distance, but, by means of the wheel and axle, the action of the lever is continued uniformly and uninterruptedly. As in the simplest form of lever, the wheel and axle creates intensity of force and loses time in proportion as the circumference of the wheel exceeds that of the axle. It is used in a variety of forms, the most common being that of the windlass.

The pulley consists of a wheel with a grooved circumference, over which a rope passes, and an axis or pin, round which the wheel may be made to turn. Pulleys are of two kinds, fixed and movable, the former has a fixed block. There is no gain of power in the case of a fixed pulley. It is used to change the direction of motion, as in the case of hoisting sails where the sailor, instead of climbing the mast to spread the canvas, stands on the deck and pulling a rope attached to a pulley raises the sails with much less difficulty. The pulley is so cheap and convenient that it is much used in its simplest forms. In complicated systems much of the power is lost by friction, and consequently such systems of pulleys are used only when large weights are to be raised.

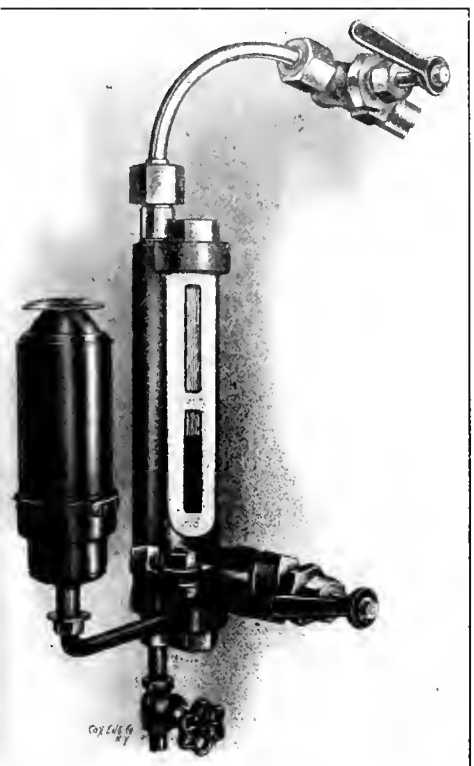
The inclined plane is the fourth of the simple mechanical powers. Any plane surface making an angle with the horizon is an inclined plane. In raising weights the work is facilitated by using the inclined plane, usually in the form of long planks or skids. This simple but useful device was known to the ancients. It is supposed that the Egyptians used it in raising the huge blocks of stone employed in the construction of the pyramids and other buildings. In the case of bodies rolling down an inclined plane, they have a uniformly accelerated motion, and attain the same velocity by the time they reach the bottom that they would have if dropped perpendicularly from the starting point.

The wedge is the fifth of the simple mechanical powers, and the power gained by its use under certain conditions is incalculable. When driven by blows the percussion gives such a shock to the parties of the body that is being penetrated by the wedge that it opens in advance of the wedge. A general law is that the longer the wedge the more easily it penetrates. All cutting instruments are wedges, the angles of inclination differing from each other to suit the material that it is intended to cut or penetrate.

The screw is the last of the simple mechanical powers. It is a continuous wedge and takes the form of a cylinder with a spiral ridge and groove winding alternately round it in parallel curves.

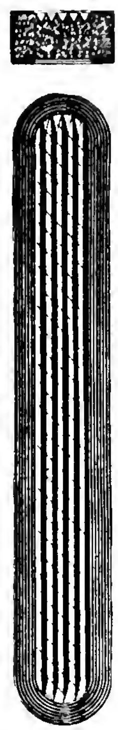
"Pressurlokd," the Prince-Groff System of Water Gauges

Various devices have been used in securing safety in the matter of water gauges on boilers. As is well known, the danger of fracture is very great, and a perfect gauge must be so constructed as to positively prevent flying glass and the blowing of hot water and steam in case a glass breaks, and at the same time the device must not in any way obstruct the view of the registering glass. The Prince-Groff Company, 30 Church street, New York, has completely perfected a system that accomplishes all this and more than this. The word "Pressurlokd," aptly chosen as the name of the new device, conveys much meaning, as the glass is pressure-locked by the steam pressure, that is, the glass is surrounded by the steam pressure. It consists of a standard reflex glass encased with a sealing metal, with the exception of the sight portion in front and the reflex portion in the rear. The joint is pressure-packed, and the sides, ends and rear of the shrouded glass are subjected to boiler pressure, therefore, it is held under compression. The locking area around the sides and ends of the metal-encased glass is twice as great as the pressure area over the sight opening. A fractured glass is therefore positively locked in position and cannot fly, thus entirely preventing the escape of steam and hot water. The outer



"PRESSURLOKD" WATER GAGE SYSTEM.

pressure upon the glass keeps the fractures closed in case it shatters. The shrouded glass is held to its seat by a resilient spring which maintains a constant pressure on the metal-sealed joint in addition to the steam pressure, and at the same time relieves the glass of all



"PRESSURLOKD" GLASS, METAL ENCASED.

strain caused by expansion and contraction of the frame, and positively prevents leaking or blowing out.

A feature of this system which is interesting is the registering column, which is immediately back of the reflex glass and the steam passageway and water column which is independent of the registering column and is for the purpose of a passageway for the steam when the steam valve is blown and also to steady the readings in the registering column thereby avoiding steam and water erosions of the reflexes of the registering glass.

The appliance has also the decided advantage of being easily cleaned without disturbing valves or joint and without removing from the boiler, and is as easily cleaned while the boiler is under pressure as when cold, and will remain in continuous service without any adjustments. To the locomotive engineer it means safety, reliability and dependability, and may even be relied upon to withstand the shock of accident or wreck. It need hardly be stated that the older types of gauges were adapted to small passage ways and angle valves which are liable to clog, and frequently do not show whether the valves are open or closed. The connections also had a tendency to loosen, and by the methods of packing with fibrous material which occasionally crept over the ends of the glass, the tendency to clog was ever present. All this is prevented by the new device, as safety having been positively secured, a large opening to the boiler is made possible with a straight-way connection from boiler to reading column of gauge, insuring a perfect reliability of readings.

In an accompanying illustration the gauge lamp is shown, which is readily adjustable to the desired point when necessary. It will also be observed that the openings to the boiler are controlled by valves with the straight type of handles that precludes the possibility of any doubt as to whether the valves are open or shut, so that every detail has been carefully mastered with the result that a water gauge possessing all the elements of safety and reliability has been brought to a degree of perfection, that leaves no tendency to defect to be remedied, and at the same time the simplicity of its construction is such that in point of economy it cannot fail to appeal to all who desire complete reliability in the matter of water gauges at a low cost

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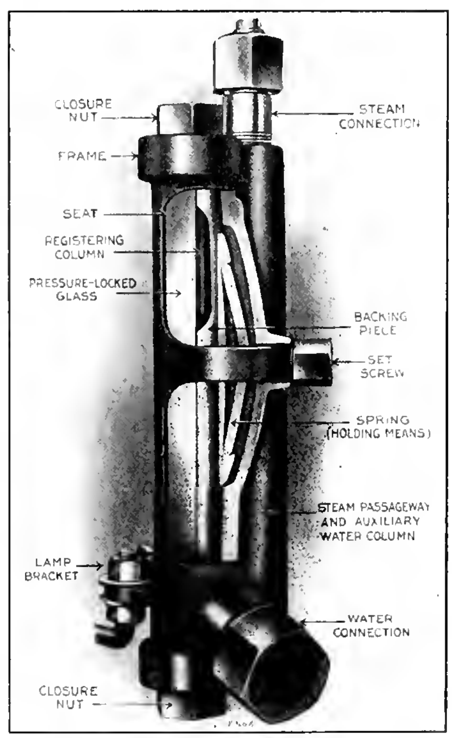
The Minister—"And does you papa say grace at the table, too?"

The Angel Child—"Yes, sir; but he doesn't say it like you do."

The Minister—"What does he say?"



SECTIONAL VIEW SHOWING INSIDE OF GAGE FRAME, DISCLOSING "PRESSURLOKD" GLASS AND MEANS OF HOLDING IT TO ITS SEAT.

The Angel Child—"He sits down an' looks round an' says, 'Great Scot, what a dinner!'"

Air Brake Department

New York Duplex Compressors.

In this issue we have several views of the New York No. 5-B Duplex air compressor, which is the present standard furnished by the New York Air Brake Co. These compressors differ from the No. 5-A in that the separate receiving valves for the high pressure air cylinder have been omitted, which reduces the number of parts without affecting the efficiency of the compressor. This compressor differs from the old standard No. 5 in the steam valve mechanism, the reversing slide valves being replaced with piston valves.

The operation of these compressors is so well known as to require no lengthy explanation, as is in the case of former types, the reversing valves control the distribution of steam to the cylinders, one piston being at rest while the other is in motion. Atmospheric pressure enters the low pressure air cylinder through the receiving valves, is compressed from the low pressure into the high pressure cylinder and from there into the main reservoir.

Air Brake Tests.

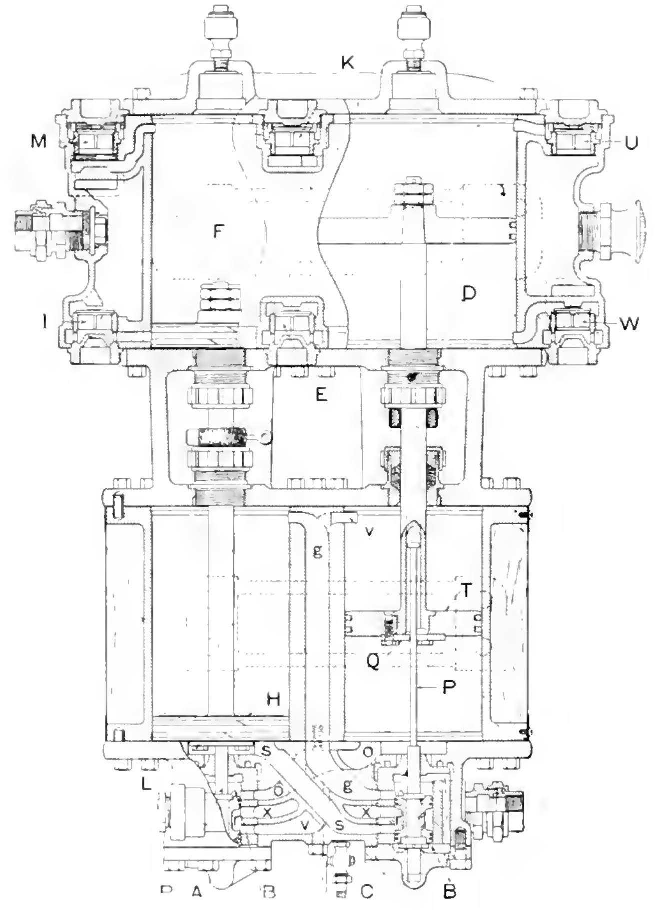
In 1913 the Pennsylvania Railroad and the Westinghouse Air Brake Company, jointly, conducted the most scientific and exhaustive air brake and brake shoe tests that have been instituted since the Westinghouse-Galton tests in 1878. The train tests were conducted at Absecon, N. J., and subsequent brake shoe tests were conducted in the laboratory of the American Brake Shoe and Foundry Co., at Mahwah, N. J.

The Westinghouse-Galton tests constituted the first scientific investigations of the action of brake shoes in retarding the motion of railway vehicles, and are still regarded as an authority and the only source of information regarding the characteristics of brake shoe friction under certain typical road service conditions, but they were made at a time when the air brake was in its infancy and but very light vehicles were in use; consequently comparatively low breaking pressures were used in the experiments and, while the results obtained remain conclusive and accurate as to general principles, those conditions do not represent the intensity of the modern air brake problem. The principal object sought in the P. R. R. tests was information which would lead to the perfection of an efficient brake for modern passenger trains, and it was understood that this could not be accomplished by air-operated devices alone, as brake shoe performance can vary the length of a stop as much as 20 per cent. or more under present-day conditions.

The engineers in charge of the tests realized that the four most important factors bearing upon the length of a train stop were: brake cylinder pressure obtained, time in which it is developed, brake rigging or foundation brake gear efficiency and the average co-efficient of brake shoe friction; hence the standard as well as several types of clasp brake were tested, plain, slotted and flanged brake shoes of various composition were used, and the P. M., U. C. and the electro-pneumatic brake equipments were tested out.

It has been some time since we have mentioned the Toledo tests of 1909, and at that time it will be remembered that a committee of the Master Car Builders' Association was called upon by representatives of several of the largest Eastern railroads, which had in course of construction heavy steel passenger cars, to "define the proper air brake equipment for passenger cars weighing 130,000 lbs. or over."

The committee met the railroad representatives at Pittsburgh, Pa. Mr. A. W. Gibbs, general superintendent motive power, Pennsylvania Railroad, was elected chairman, and Mr. A. L. Humphrey, general manager of the Westinghouse Air Brake Company, was asked to explain the object of the meeting.



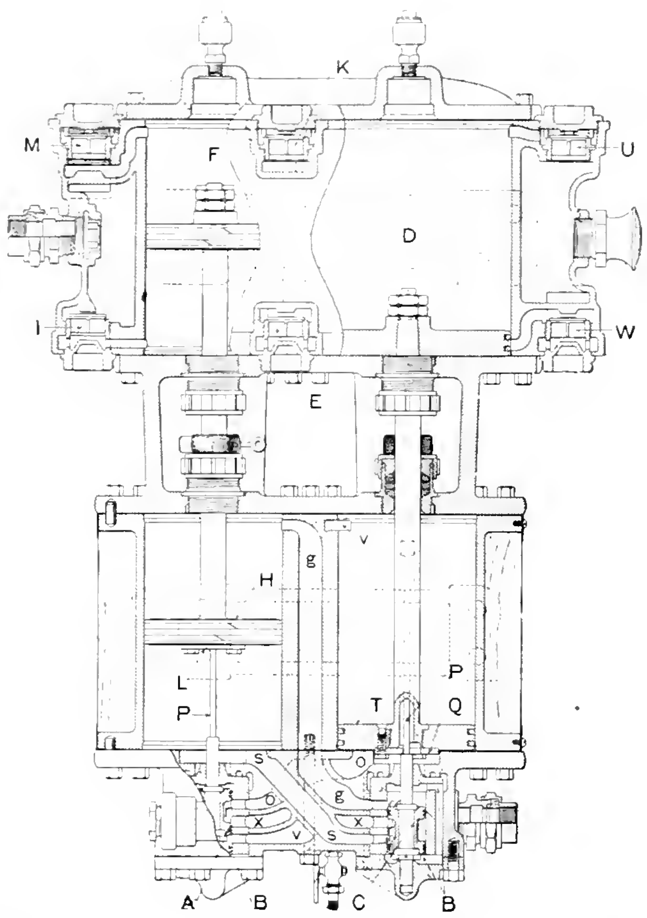
1559—NEW YORK DUPLEX COMPRESSOR. LOW PRESSURE PISTON ON UP STROKE.

Mr. Humphrey outlined the proposition confronting the air brake company, which was to furnish a brake equipment for cars weighing from 140,000 to 150,000 lbs. and which had outgrown the foundation brake rigging of that day, and pointed out that a radically new design of rigging was imperative, and further stated that the conditions might possibly be met thereafter with a 20-in. brake cylinder, a double brake equipment per car, a clasp type of foundation brake gear or a lengthening of the brake cylinder piston travel, all of which with the exception of the clasp

brake were decidedly objectionable, and it alone could not be expected to solve the problem.

While discussing the subject, the consensus of opinion was that the brake apparatus had not kept pace with the increased weights and speed of the modern passenger train, and the chief factors which necessitated the different treatment in the application of braking forces were:

1. Increased unbraked locomotive weight.
2. Increased train momentum.
3. Increased brake rigging deflection and false motion, due to severe stresses in car members and other causes, which greatly increase the piston travel.
4. Increased brake leverage ratio, with consequent increased piston travel and lower maximum cylinder pressure.



1562 NEW YORK DUPLEX COMPRESSOR. HIGH PRESSURE PISTON ON DOWN STROKE.

5. Increased time to obtain brake effectiveness, on account of large cylinder volumes.
6. Decreased brake shoe co-efficient of friction, due to greater brake shoe pressure and speeds.
7. Possible breaking down of the brake shoe under the severe conditions imposed.

In order that the problem might be considered from both a practical and theoretical standpoint, a sub-committee was appointed to determine the scope of and establish a basis for the investigation, and the following resolutions were unanimously adopted by a vote of the railroad representatives present:

Resolved, That it is the sense of this meeting that the air brakes provided for the heavier passenger cars now building shall be of such design, proportion and capacity as to enable trains of the said heavier passenger cars to be stopped in practically the same distance after the brakes are applied as is now the case with existing lighter cars; and be it further

Resolved, That for the use of this committee and others interested in making calculations we suggest that it be assumed that the theoretically desirable stop is one which required the space of not over 1,200 ft. after the brakes are applied, the speed of the train at the time of the application of the brakes being sixty miles per hour.

Another sub-committee was then appointed to make recommendations as to the maximum load per brake shoe, from which figure would be calculated the percentage of retardation necessary and also to make recommendations as to the number of shoes per car for different weights of cars.

From tests made in the laboratory of the American Brake Shoe and Foundry Company, indications were that a mean co-efficient of brake shoe friction as high as 10 per cent. could probably be realized, under modern conditions, and tests also indicated that the maximum brake shoe pressure employed should never exceed 18,000 lbs. per shoe, or 400 lbs. per square inch. A great deal of additional reliable information was obtained and placed before the committee, but before an acceptance of the recommendations the committee decided that a demonstration should be made by actual road tests of which records should be taken. In the meantime the representatives of the Lake Shore and Michigan Southern Railroad presented this matter to the officers of that road who arranged to have the tests conducted at Toledo, Ohio.

How the P. M., L. N. and L. G. N. brake equipments failed in producing a stop in the specified distance and how the P. C. equipment was developed and met the requirements is now a matter of air brake history, for during the limited time of the tests the Westinghouse Air Brake Company were able to design, build and install the first type of P. C. brake and by its use shortened the stop beyond the specified distance and reduced the lapsed time between brake application and brake effectiveness to two seconds.

The performance of this brake also proved that, in order to meet the conditions, an emergency braking ratio 100 per cent. greater than that used for service operation was necessary, and that brake application and brake effectiveness should theoretically be as near instantaneous as possible even if electric current was necessary to shorten this lapsed time.

During the tests, a train of heavy steel 8-wheel cars of the Pennsylvania Railroad were run for the purpose of comparison with the stops made with the 12-wheel cars of the Lake Shore Railroad, and there was but very little difference in the length of stops either with the H. S. brake or the L. N. equipment; that is, 8-wheel cars were stopped in about the same distances under the same conditions as 12-wheel cars, but with the L. G. N. brake the stop was 150 ft. longer, and with the H. S. brake 500 ft. longer than the 1,200 ft. decided upon as a reasonable distance by the Master Car Builders' Committee.

As a result of the tests, the New York Central Lines adopted the P. C. brake for heavy passenger cars, but the test department of the Pennsylvania Railroad conducted another test with various types of brake shoes and the clasp type of foundation brake rigging, and again found that the heavy steel passenger cars could not be stopped in the required distance with triple valve equipments. The Westinghouse Air Brake Company then designed and built what is known as the U. C. equipment for the Pennsylvania Railroad. This brake, which has been described and illustrated in these columns, can be operated either electrically or pneumatically, and when referred to as the U. C. it will indicate pneumatic

operation and when as U. E. or electro-pneumatic it will indicate that the transmission of the application was electric.

This is the improved brake that was tested out at Absecon, N. J., in 1913, and any statements hereafter will have reference to those tests.

The object of the tests was to determine the best air brake equipment, brake shoe and foundation brake arrangement for heavy steel cars. Those who have read the descriptions of the U. C. brake will understand that it contains a number of greatly desired features not possessed by triple valves, which it was also proposed to test out. The principal improvements sought were shortening the emergency stop, safety and protective features necessitated by severe service conditions, uniformity of brake application on all cars, certainty of application and release, added flexibility for service operation, and a separation of service and emergency functions; that is, assurance of quick-action when required and absolute prevention during service operation.

When a shortening of the emergency stopping distance with modern equipment is contemplated, there are a number of factors involved which must receive due consideration. One of the most important is what is termed the brake rigging efficiency.

Deflection of rigging and lost motion throughout the car members tends to increase emergency piston travel to such an extent that full brake cylinder pressure cannot be attained and in many instances a large percentage of the force developed by the brake cylinder, to be transmitted to the brake shoes, is lost through inefficient brake gear and lost motion.

It is also recognized that the shortest possible emergency stop involves a wide difference between service and emergency braking ratio. The braking power for service operation is based upon the light weight of the car, and during the actual stop this braking power is a variable quantity; hence it is termed the nominal percentage of braking power because it is a very meaningless term when the actual retarding force obtained between the wheel and the rail during a stop is considered. As service braking force is calculated for low speeds and protection against wheel sliding, it has been proven that much higher braking forces can be used for emergency stops, and that full braking power can be retained to the stop without injury to the wheel, and must be retained if the shortest possible stop is desired.

As the actual force tending to check the rotation of the wheel when the brake is applied averages but about 10 per cent. of the pressure applied to the brake shoes during modern high speed stops, and as percentages of braking power as applied to car brake equipment and actual retarding force obtained are widely different quantities, one of the principal objects sought in the tests was to find the maximum rate of retardation that could be obtained with reasonable protection against damaged wheels from sliding, or, in other words, the percentage of braking power that could be used for emergency stops without injurious wheel sliding, and as this is governed by the adhesion between the wheel and the rail, it follows that limit of braking power cannot be so low as to absolutely prevent slid flat wheels under all unfavorable conditions of the rail and yet cannot be so high as to produce a retarding effect that would exceed the adhesion of the wheel to the rail under average conditions.

When the term, percentage of braking power, is used, it will, of course, mean that which is calculated upon the light weight of the car. One hundred and fifty per cent. braking power will mean that the total brake shoe pressure is calculated to be 150 per cent. of the light weight of the car.

Service braking power is usually based upon 90 per cent. of the light weight of the car for either the P. M. or P. C. equipments; with the former it is based upon a 60-lb. cylinder pressure, with the latter upon an 86-lb. pressure, which is the point of equalization of the service reservoir and service brake cylinder.

This is accomplished with a 24-lb. brake pipe reduction, and the same reduction brings the brake cylinder pressure of the P. M. brake up to 60 lbs., or the adjustment of the high speed reducing valves. In fact, it is recommended that for passenger service the auxiliary reservoir and brake cylinder be proportioned and the brake levers arranged to produce 3¾ per cent. braking power per pound of brake pipe reduction.

Another factor to be considered in obtaining an efficient brake is a mechanism that can develop a brake cylinder pressure that will give this wide difference between service and emergency braking power on a single cylindered car, and develop it quickly enough to bring a train stop to the M. C. B. requirements.

The efficiency of the brake shoe in transforming the pressure applied to it into retarding effect at the surface of the wheel will be mentioned in connection with the subject of brake shoe tests.

A train of 12 steel passenger cars weighing about 61 tons each and a Pacific type locomotive weighing about 200 tons were used in the tests. Total length of train was 1,040 ft. The locomotive brake was the No. 6 E. T., but at times a special by-pass valve was used to obtain a quicker rise in emergency brake cylinder pressure and a higher than standard pressure in the engine and tender brake cylinders at times when the electro-pneumatic brake was in use. The object was to have the locomotive brake more nearly equal to the electro-pneumatic brake on the cars so that, on account of the higher efficiency of the U. E. brake, it would not be compelled to retard a greater per cent. of locomotive weight than the P. M. equipment under similar conditions of stop.

One hundred and ten pounds brake pipe pressure was considered as standard for passenger service, and cars were equipped with three different styles of brake, the P. M. or triple valve equipment, the U. C. built up to equal the features of the type P triple valves, the complete U. C. and the U. E. or electro-pneumatic.

The cars were at different times equipped with the standard and clasp type of foundation brake gear, the latter in three different styles, and at the beginning of each run the piston travel was adjusted to 6½ ins. with a full service application. Six hundred and ninety-one tests were made during the three months and twelve days' time.

The most modern apparatus was used for obtaining records of the tests, both on the train and along the track; the cars were furnished with brake cylinder indicators and wheel sliding indicators. Indicators for measuring slack action were used in different portions of the train, and telephones located in a number of the cars facilitated communication.

Specially designed apparatus was used for measuring the brake shoe pressure delivered to the shoes during some of the tests; the object was to determine the brake rigging efficiency. The usual chronograph was used on the train; this instrument gives an accurate record of speed, rate of deterioration, distance of stop, time of stop, brake pipe and brake cylinder pressures. The train was also equipped with the electro-pneumatic train signal system.

As to the results of tests, the reader will understand that distance of emergency stop was not the sole consideration, but that improved features of the universal valve, which is the operating valve of the U. C. and U. E. equipments, were also demonstrated. A detailed account of these need not now be given, as articles on the electro-pneumatic brakes that have appeared in the Air Brake Department of this magazine were based upon the results of these tests, and the improved features in the design of the universal valve were fully demonstrated. Certainly a few minor changes in mechanical construction of the valve were made as a result of the rigid test, but the original type of valve was used throughout the test without change.

The engineers of the P. R. R and the W. A. B. Co. have made a thorough analysis of all the tests, which fills a volume in air brake literature, and while it will be impossible to go into the results in detail this subject will be mentioned in future issues.

As a fair comparison of the P. M. and

the U. E. brakes, a result of emergency stops, which is always interesting, will be given.

But for the fact that the emergency stopping distances with any type of brake can now be so closely calculated, the performance of the electro-pneumatic brake in railroad service would have exceeded Mr. Turner's fondest expectations.

From a speed of 60 miles per hour on a level track, these 12 car trains of 120,000 lbs. per car were stopped with the P. M. equipment in an average of about 1,600 ft. Emergency braking power 113 per cent.

The U. C. brake with 150 per cent. braking power produced a stop 200 ft. shorter than the P. M. brake.

Twelve car trains can be stopped with the electro-pneumatic brake from 60 miles per hour speeds, 150 per cent. braking power in less than 1,200 ft.

The shortest stop made with 12 cars running at 60 miles per hour was made in 1,021 ft. distance. This was made with 180 per cent. braking power, clasp brake and high braking power on the locomotive.

The shortest stop for a single car, sixty miles per hour, breakaway (stop without locomotive), 180 per cent. braking power, clasp type (two shoes per wheel), foundation brake rigging and flanged brake shoes, was made in 725 ft. distance, establishing a new record for car stops.

These demonstrations prove conclusively that a brake has been provided for heavy cars that is as efficient as any brake ever used on lighter cars, and a contributing factor that stands out prominently is the time of application. As a result of an emergency application the brakes of the P. M. start to apply on the first car in less than 0.5 of a second; on all cars in two seconds. Maximum brake cylinder pressure is attained in 8 seconds.

Compared with the U. E. brake, the emergency (electric) applies the first brake in less than 0.5 of a second, and all brakes in less than 0.5 of a second, and maximum brake cylinder pressure is attained in 2.25 seconds.

As electric control adds no braking power, the effect of the time element in brake application stands out very clearly. The U. E. brake is working its maximum capacity 5¾ seconds ahead of the P. M. brake; in fact, the U. C. equipment develops maximum emergency brake cylinder pressure 4½ seconds quicker than the P. M. brake, and obviously this remarkable shortening of the emergency stopping distance is due principally to high emergency braking power and the reduction in the time of application.

To just what extent each contributes is rather a difficult matter to accurately determine under the various conditions, but during one series of tests, using 150 per cent. braking power, the quicker and more powerful emergency application of the U. C. brake shortened the stopping distance from the 60-mile-per-hour speed from over 1,600 ft. made by the P. M. brake to about 1,400 ft., and the instant and simultaneous action of the U. E. brake still further shortened this stop to less than 1,200 ft. On the other hand, it was also noted that with the U. E. brake, for every increase of 5 per cent. in braking power (within the ratios of 90 per cent. to 180 per cent.), the length of the emergency stopping distance is shortened 2 per cent.

In a series of stops where the by-pass or higher braking power was used on the locomotive, all other conditions being equal the electric emergency application of the U. E. brake, 180 per cent. braking power produced a stop from 60 miles per hour in 1,020 ft.

It was determined that improvements in stopping distances could be made in any or all of the controlling factors with the possible exception of co-efficient of brake shoe friction; that is, in type of brake, foundation brake rigging and nominal percentage of braking power employed, or as one of the factors were heightened another could be correspondingly lowered, the distance of the stop remaining the same; that is to say, if the brake rigging efficiency or the brake shoe effectiveness is increased, the percentage of emergency braking ratio could be lowered if considered desirable; however, it was clearly proven that the determining factor in wheel sliding is not high braking power alone, but rather depends more upon rail and weather conditions.

Another advantage of the U. E. brake in the transmission of emer-electric emergency applications is that it eliminates shocks even if used at low speeds.

While we cannot be favorable to emergency applications at low rates of speeds unless it is absolutely necessary to prevent an accident, and believe that in many instances enough wheels are locked in this manner to lengthen the distance of stop beyond that which would result from a service application, the U. E. equipment can be used in this position at any rate of speed without any danger of break-in-two or shock even if used at a rate of 10 miles per hour. At this rate of speed a pneumatic emergency application is in effect equal to a collision between the rear and forward end of the train.

While nearly all of this reference is to the emergency or safety features of the universal valve, it may be surprising but a fact nevertheless that 80 per cent. of the improvements in the universal valve over the triple valve are in the service features, and as it is impossible to give a very comprehensive result of these epoch-making tests in a single number, they will be referred to in subsequent issues, and it may be relied upon that we will take care to furnish such information that may be relied upon absolutely.

Air Brake and Triple Valve Grease.

Dixon's Graphite Air Brake and Triple Valve Grease for use in brake cylinders is designed to be used anywhere in the air brake system. It keeps the packing leathers in the best of condition and insures most delicate and positive regulation of the air brake equipment. The fact that this lubricant has been adopted as the standard on many roads for the air brake equipment, as well as the signal equipment, only after long and severe tests under most trying conditions, is conclusive proof of its great merits. It has the merit of getting to the various parts with the air, and retains its consistency in all kinds of temperature.

Neglecting to Make Wheel Reports.

The management of the Erie has found it necessary to protest to certain conductors for being negligent in transmitting their wheel reports promptly after completion of their runs; also account of showing incorrect engine and car numbers, initials and omitting portion of the information called for on these reports.

The result is that the superintendent of transportation is prevented from completing per diem settlements with other roads for use of their cars and reporting mileage made by passenger equipment.

Conductors who display carelessness in performance of that important duty are likely to be careless on matters that jeopardize the safety of train operating. Omitting discipline for the offense is mistaken kindness.

Suggestions from Employees to be Paid For.

The management of the Erie Railroad has decided to offer a prize of $25 on July 1 and on January 1 for the best suggestions made during each preceding six months' period for improving or safeguarding operations.

Many valuable suggestions have been received from time to time in the past, but it is felt that the experience of more employees has fitted them with special knowledge that would be of great value to the successful operation of this railroad, if made known, and put in use. It is appreciated that suggestions have been and will be received worth many times the amount of the prize, which, therefore, is not to represent the value that is placed upon the suggestions by the officers, but as a token of appreciation and to stimulate interest in the efforts for closer co-operation.

All classes of employees are eligible for this prize, except officers, and suggestions are invited for improving, safety, reducing the cost of various operations, increasing the efficiency to patrons, or along any other lines that will make the Erie Railroad bigger, better and safer.

Consolidation Locomotives for the Western Maryland Railway

Twenty consolidation locomotives having a tractive power of 61,300 pounds were recently delivered to the Western Maryland Railway by the American Locomotive Company. These locomotives were built to give the greatest possible tractive power obtainable within the axle load limitations.

The mechanical department of the railroad, after carefully studying the physical conditions of the division, decided that a comparatively low factor of adhesion of 3.55 could be safely used. By the use of this factor of adhesion of 3.55 and a driving wheel 52 inches in diameter, this tractive power of 61,300 pounds was obtained without sacrificing boiler capacity. It is therefore very interesting to note the wonderful work these engines are doing. It also proves the possibilities of this type of engine with a relatively small driving wheel for service where speed does not become a factor.

After leaving Cumberland, eastbound, the line runs over an undulating profile, on which the maximum grade against eastbound traffic is 0.3 per cent. for 74 miles to Williamsport, Md. From here it rises on a 1 per cent. grade into Hagerstown, about 6 miles. On this division the railroad company figured these consolidations to haul 4,725 tons.

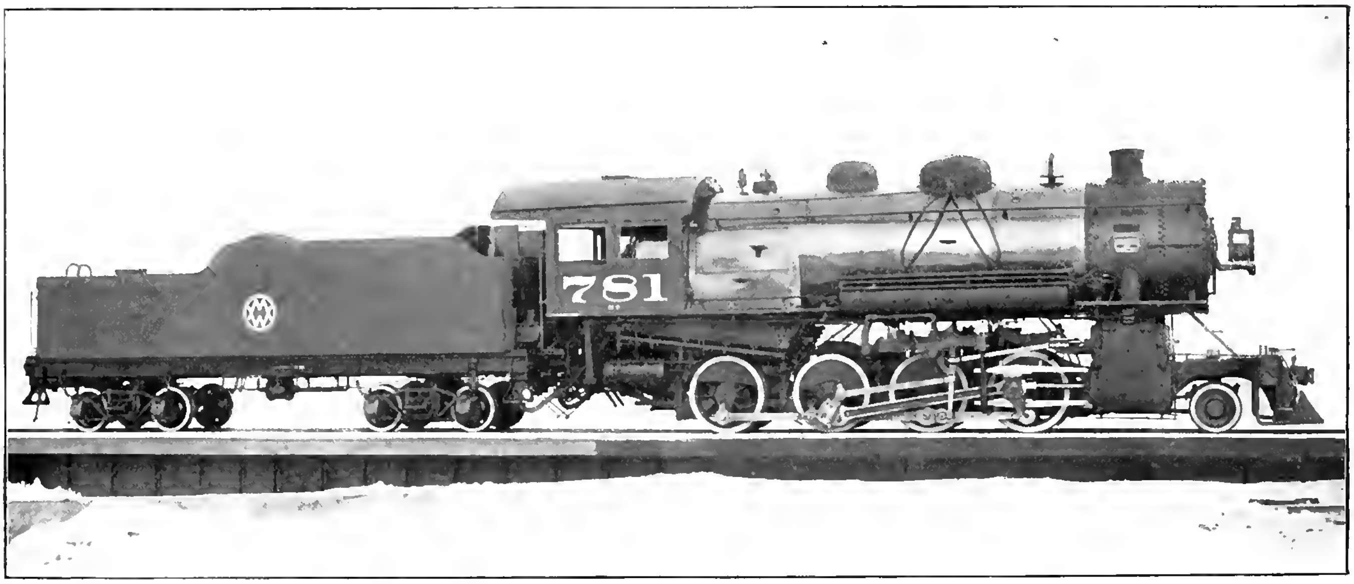
On May 20 one of these consolidations left Cumberland at 2:30 A. M. with 114 loaded cars, weighing 7,014 tons, and arrived at Williamsport at 9:18 A. M. At this point 15 loads were set off and the train was given two Mallet helpers, leaving at 10:04 A. M. and arriving at Hagerstown at 11:05 A. M., having been on duty from the time they were called until released at Hagerstown, 8 hours and 35 minutes. Many such runs have been made since this time and it is now getting to be common. The astonishing fact to every one is the overload which these engines take care of.

Such heavy trains demand exceptional boiler capacity. The boiler is of the straight top type. It is 82 inches in diameter at the front end and 87 inches in diameter at the largest course. The barrel is fitted with 239 tubes $2\frac{1}{4}$ inches in diameter, 36 flues, $5\frac{1}{2}$ inches in diameter and 15 feet 3 inches long. The tube spacing is 13-16 inch. The firebox is 110 inches long and $80\frac{1}{4}$ inches wide, and has a throat depth of 22 inches; measuring from the top of grate to the center of lowest tube.

According to the American Locomotive Company's new ratios, 25 inch cylinders with 200 pounds pressure gives a cylinder horse power of 2,252. One horse power hour requires 20.8 pounds of superheated steam. Total steam required per hour equals 2,252 x 20.8 or 46,840 pounds. Firebox and firebox water tubes have an evaporation of 55 pounds of steam per square foot of heating surface. Tubes $2\frac{1}{4}$ inches in diameter, 15 feet 3 inches long, spaced 13/16 inch have an evaporation of 10.605 pounds per square foot of heating surface; and flues $5\frac{1}{2}$ inches in diameter, 15 feet 3 inches long, spaced 13/16 inch have an evaporation of 11.625 pounds per square foot of heating surface. This boiler has a heating surface for firebox and firebox water tubes of 228.5 square feet, for tubes of 2,133.7 square feet, and for flues 785.6 square feet. The evaporation for firebox and water tube is 228.5 x 12,570 pounds; for tubes, 2,133.7 x 10,605 or 22,630; for flues, 785.6 x 11.625 or 9,200 pounds; giving a total evaporation of 44,330 pounds. The evaporation of the boiler, 44,300 divided by the evaporation required, 46,840, gives a 95 per cent. boiler.

Maximum cylinder horsepower would not be reached until this engine was running 31 miles per hour. As the service in which these engines are working will not require any such speed, a 95 per cent. boiler will have ample steam making capacity. Mr. H. R. Warnock, Supt. Motive Power, states as follows: "With the poorest quality of coal I have ever seen, the fireman had no trouble in putting up the second pop; and it makes no difference how long you full stroke this engine, there is always 200 pounds of steam on hand."

This design was developed by the mechanical department of the Western Maryland in co-operation with the American Locomotive Company as a part of the program of this road in reducing operating costs. Interesting details included are the Baker valve gear, firebrick arch, superheater, outside steam pipes, Woodard engine truck, long main driving box, Foulder main rod and vanadium cast steel frames.



2-8-0 TYPE LOCOMOTIVE FOR THE WESTERN MARYLAND RAILWAY

H. R. Warnock, Superintendent Motive Power. American Locomotive Company, Builders.

The following are the general dimensions of these locomotives:

Track gauge, 4 ft. $8\frac{1}{2}$ ins. Fuel, bituminous coal.

Cylinder—Type, simple piston; diameter, 25 ins.; stroke, 30 ins.

Tractive power—Simple, 61,300 lbs.

Factor of adhesion—Simple, 3.52.

Wheel base driving—16 ft. 8 ins.; rigid, 16 ft. 8 ins.; total, 26 ft. 2 ins.; total, engine and tender, 68 ft. 0 ins.

Weight—In working order, 244,500 lbs.; on drivers, 217,500 lbs.; on engine

truck, 27,000 lbs.; engine and tender, 424,000 lbs.

Boiler—Type, straight top, O. D. first ring, 83¾ ins.; working pressure, 200 lbs.

Firebox—Type, wide; length, 111 ins., width, 80¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4½ ins.; sides, 4 ins.; back, 4 ins.; depth (top of grate to center of lowest tube), 22 ins.

Crown staying—Radial.

Tubes—Material, Spellerized steel. Number, 239; diameter 2¼ ins.

Flues—Cold Drawn Steel Number, 36; diameter, 5½ ins.

Thickness—Tubes, No. 11 B. W. G.; flues, No. 9 B. W. G.

Tube—Length, 15 ft. 3 ins.; spacing, 13/16 in.

Heating surface—Tubes and flues, 2,919.3 sq. ft.; firebox, 202 sq. ft.; arch tubes, 26.5 sq. ft.; total, 3,147.8 sq. ft.

Superheater surface—594.4 sq. ft.

Grate area—61.3 sq. ft.

Wheels—Driving diameter outside tire, 52 ins.; center diameter, 45 ins.; driving material, main, cast steel; others, cast steel; engine truck, diameter, 30 ins.; tender, 33 ins.

Axles—Driving journals main, 11 x 20 ins.; other, 9 x 12 ins.; engine truck journals, 6 x 12 ins.; tender truck journals, 6 x 11 ins.

Boxes—Driving main and others Gun iron.

Engine—Truck, 2-wheel, Woodard type

Exhaust pipe—Single nozzles 1-5⅝ ins

Grate—Style, Rocking.

Piston—Rod diameter, 4 ins.; piston packing rings, Gun iron.

Smoke stack—Diameter, 18 ins.; top above rail, 14 ft. 11⅞ ins.

Tank—Style, Water bottom; capacity, 9,500 gals.; fuel, 14 tons.

Tender frame—A. L. Co's. built up type.

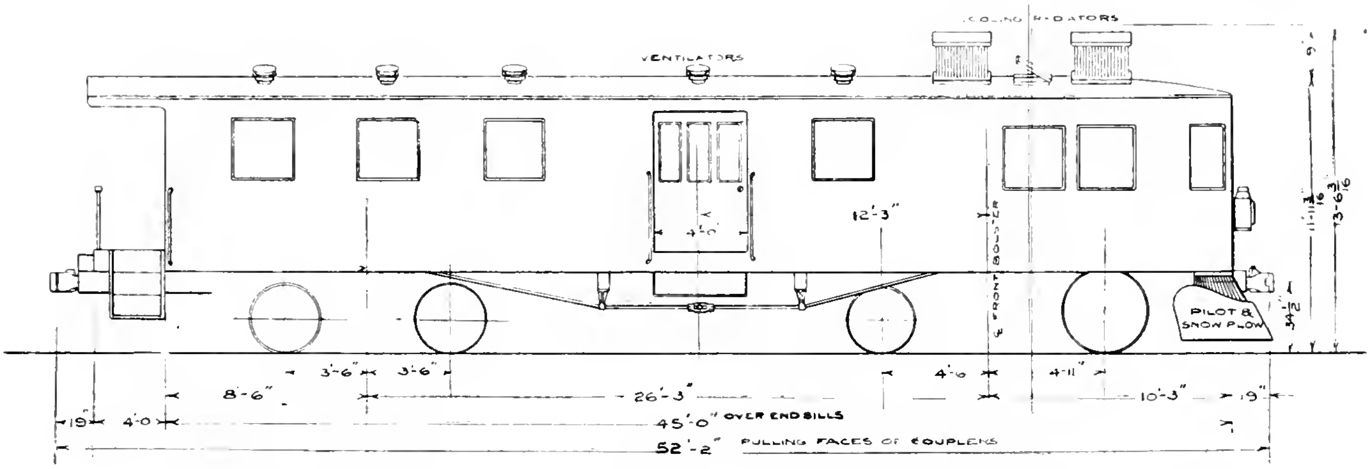
Valves—Type, Amer. Semi-Plug; travel, 6½ ins.; steam lap, 1 in; ex. CL line and line; setting, ⅛ lead.

McKeen Motor Freight Car

For the Minneapolis & Northern Gasoline Motor Railway

The Minneapolis & Northern Gasoline Motor Railway has recently purchased a gasoline motor freight car from the McKeen Motor Car Company which is being used for freight and express service between Minneapolis and Anoka, Minn. It is a semi-convertible car which, during periods of heavy passenger traffic, can be used for transportation of passengers—removable seats and chairs being installed for that purpose.

It is equipped with the McKeen Motor Car Company Type "A" Motor Truck in which has been incorporated many of the important fool-proof and economic features of the latest model Type "C" Motor Truck. The air brake system has a special Gregory motorman's valve for operation of straight air on motor car and automatic air on trailers.



McKEEN MOTOR FREIGHT CAR FOR THE MINNEAPOLIS & NORTHERN GASOLINE MOTOR RAILWAY.

The car's length over end sills is 45 ft., while the total length is 52 ft. 2 ins.

The accompanying side elevation illustrates the general design of the car, from which it will be noted that the front end is wedge shaped and the rear end has a platform for passengers' ingress and egress. The McKeen depressed center side entrance is not a feature of this car, inasmuch as its use is chiefly for freight and express service. The car structure consists of a metal underframe, and continuous 2 in. grooved steel combination side posts and carlines extending from side sill to side sill with metal diagonal bracing. The outside and inside wall sheathing is of 13/16 in. fir. The floor is of 1⅝ in. fir. Main dimensions are:

Length over end sills	45 ft. 0 ins.
Length over platform	49 ft. 0 ins.
Length over all	52 ft. 8 ins.
Width over side sills	9 ft. 8 ins.
Width over sheathing	9 ft. 9⅝ ins
Width over all	10 ft. 4⅛ ins.
Width inside	9 ft. 2⅜ ins.
Length, freight compartment	33 ft. 11¾ ins.
Height, rail to roof	11 ft. 11 3/16 ins
Weight	56,000 lbs.

Redeeming New Haven Road.

Receiving bricks viciously thrown has long been the misfortune of the New Haven road, but we now notice changing sentiment veering about the company's action in the pensioning of old employees:

Supplementing its action of last March when thirty-eight faithful employees were retired on pensions, the board of directors of the New Haven has placed thirteen additional names on the company's pension roll, making a total of fifty-one employees retired in a period of three months on pensions aggregating $1,547 a month.

These employees have been placed on the company's pension list in conformity with its practice of providing for those who have performed long and faithful service for the company. Under its system those who have had thirty years of continuous service and are pronounced incapacitated by a physician can apply for a pension, the basis of such pensions being one per cent. of the average monthly earnings for the past ten years for each year of service, with the maximum fixed at 40 per cent.

In the list just pensioned there are three crossingmen, two switchmen, two watchmen, one clerk, one foreman painter, one train baggagemaster, one station baggagemaster, one section foreman and one track foreman. The average age of these is 69.8 years and the average length of service 41.8 years. The pensions awarded the thirteen will aggregate $286.72 a month.

It is very much to the credit of the railroad company that the threatening conditions under which their great work is carried on, their philanthropic plans are not disturbed.

Electrical Department

The Aluminum or Electrolytic Lightning Arrester.

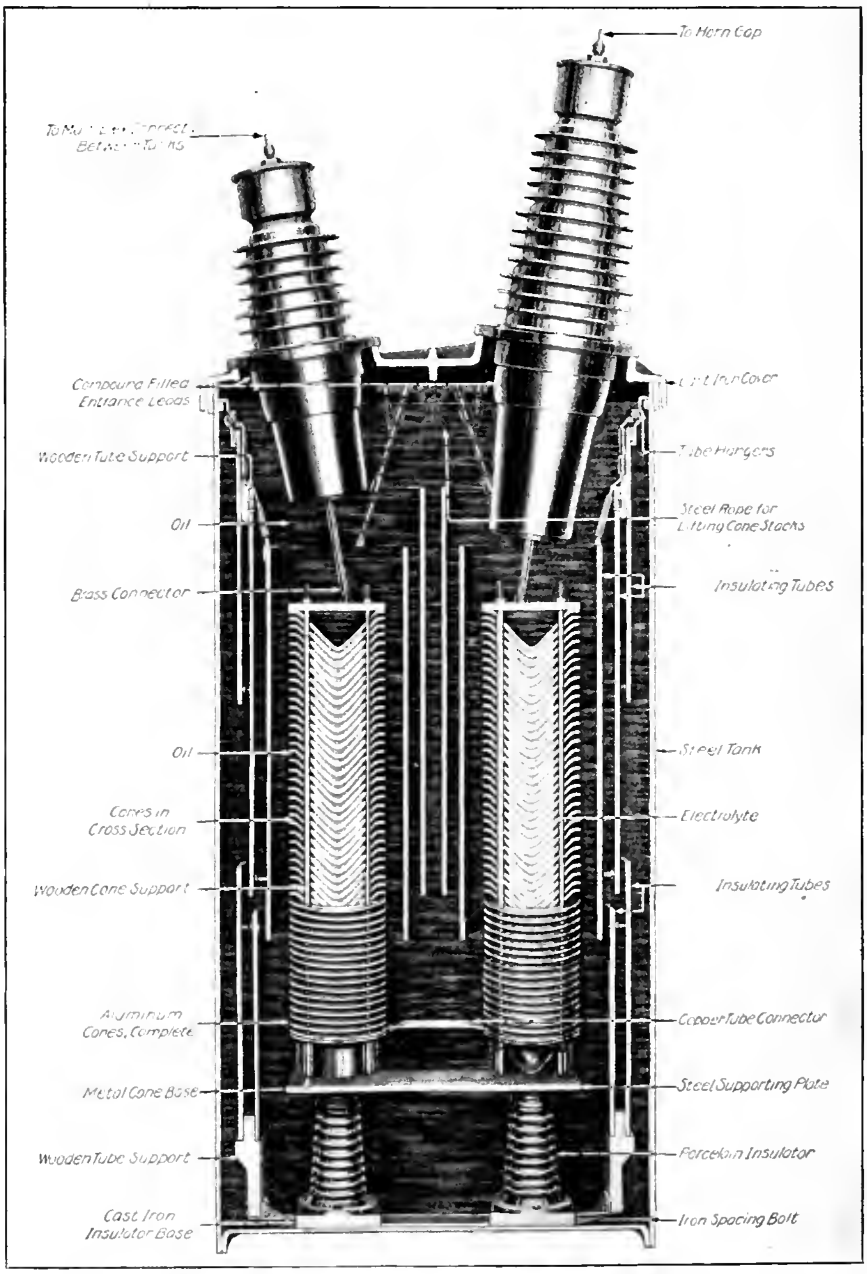
It is very important to provide some means of protecting transmission wires or circuits, over which electric power is flowing, against lightning and potential surges. Some transmission lines extend over distances as high as 300 miles and are greatly exposed to lightning. Moreover, most of the lines are at high voltage, some being as high as 110,000 volts. On these high voltage transmission systems, potential surges are easily set up, i. e., voltages several times normal may be formed and must be dissipated.

The electrolytic arrester has proven itself far superior to any other type on these high voltage systems, for it has an enormous discharge capacity. They can also be adjusted to operate or discharge at only a small percentage above the normal voltage.

The design of the arrester is based on the characteristics of the aluminum cell which consists of two aluminum plates on which has been formed a film of aluminum hydroxide, there two plates being spaced less than 1 inch apart and enough of the electrolyte, consisting of aluminum hydroxide in solution, placed in the bottom plate to touch the top one. This film has a peculiar although an important characteristic, known as its critical voltage. Up to a certain voltage between the two plates only a very small current flows, but if this voltage is exceeded ever so little the film breaks down and a heavy current discharge can pass through. The operation of the film is analogous to the steam safety valve, which confines the steam until the pressure exceeds a certain given value. The breaking down of the film does not take place in one spot, but the discharge takes place equally over the entire surface of the film touched by the liquid. The breaking down points are minute and are thickly and evenly distributed.

From the characteristics of this cell it is easily seen that when lightning strikes the line the high voltage will at once break down the film and the lightning will diffuse through the arrester. As soon as all of the lightning energy is dissipated, the power current will tend to follow, as the film is in a broken-down condition. However, at that time the voltage will be normal and the passage of this power current through the electrolyte will again build up the film and choke off the current. This occurs immediately after the lightning energy has stopped.

This film formed on the aluminum plates will dissolve if the lightning arrester is left idle, and it is necessary, periodically, to connect the cells to the circuit so that a small amount of current will flow and keep the film to its full thickness.



ELECTROLYTIC LIGHTNING ARRESTER FOR VOLTAGES 110,000 TO 150,000.

The construction of these arresters is rather interesting. The illustration shows one for operation on 150,000 volts. It consists of a series of plates or cones, the number depending on the voltage of the power circuit, placed one above the other at a distance of approximately 4/10 inch. The electrolyte is poured into the cones, partially filling the space between adjacent ones. A certain amount is placed in each one, a small measuring can being used to get the desired amount. Each plate is insulated from the other by means of porcelain insulators, and after all the plates are assembled the tank is filled with oil. On the high-voltage types insulating tubes are placed inside of the tank to increase the insulation. The grade of oil used is known as transformer oil, which not only improves the insulation and prevents evaporation of

the electrolyte, but conducts away the heat generated during the discharge of lightning through the arrester.

There is installed with each arrester a horn gap which is connected in series with the tap from the supply. The horn gap serves a triple purpose:

1. The fixed gap in series with the cells prevents the arrester from being subjected continually to the normal line voltage, which would overheat the cells.

2. They act as a disconnecting switch, enabling the removal of the arrester for repairs, inspection, etc.

3. They are so designed that they can be used as a connecting switch for daily charging. As mentioned above, the film will gradually dissolve and, by bringing the gaps together for a few seconds, enough of the power current will pass through the arrester to build up the film.

The arresters should be charged daily, for by this means they are kept in the best of condition.

On the lower voltage lines in the neighborhood of 20,000 volts, the lightning arrester and horn gaps are usually placed indoors. For higher voltages it is the practice to instal them out of doors, and this arrangement has met with general favor.

Care must be taken to prevent too great a variation temperature, for the electrolyte will freeze at about 20 degs. F. and the film will dissolve very rapidly if the temperature of the arrester exceeds 100 degs. F. Thus it is very important to protect the arrester from the direct sun's rays and cold weather to get the best operating results.

Electromagnetic Hammer.

Electric drive has increased rapidly on all kinds of machine tools and is working into many new fields. One of the latest applications is in connection with small riveting hammers which are generally operated by compressed air. It is perfectly feasible to get the hammer blow by means of the electromagnet, but the difficulty has been to prevent sparking when the current is broken to allow the hammer to return to its first position ready for the next blow. L. Schueler, in the *Elek. Feit* for May, 1914, describes a method which he has used very successfully. The design is shown by Fig. 1. Only the hammer blow is produced by the electric current, as the armature H of the electromagnet (M) is carried back by a spring (S).

These hammers operate on alternating current so that the pull on H is not constant, but periodical at so many times a minute, depending on the frequency of the electric current. To prevent the sparking the control is such that the circuit to the electromagnet is broken when the current value passes through the zero value. Due to the time required to return the armature H with the spring, it is only possible to get the hammer blow every fourth cycle. For instance, with an alternate current of 60 cycles there would be 20 hammer blows per second, which is the usual number for compressed air hammers.

Another Use for the Electric Fan.

During the hot days of summer the electric fan is kept constantly in use in offices, public buildings, etc., for the comfort of mankind. In Salt Lake City the fan, probably for the first time, has been installed in the stables of the Utah Light & Railway Company. The cost of operating the fans is about 40 cents per horse per month, but is inexpensive when it is considered that the horse will render more work due to the better ventilation of the stable and the elimination of the fly nuisance.

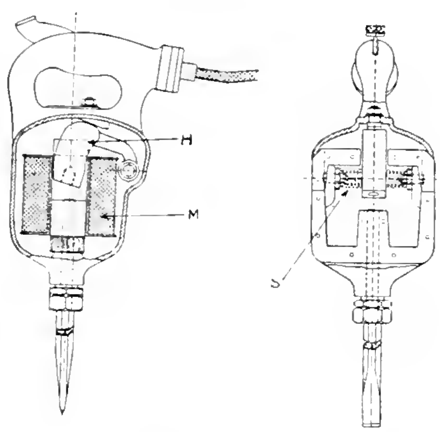


FIG. 1. ELECTROMAGNETIC HAMMER.

Electrification of the Chicago, Milwaukee and St. Paul R.R.

The C. M. & St. P. R.R. will place shortly an order for substation equipment and electric locomotives. It is expected that the first section of 113 miles between Three Forks and Deer Lodge, Mont., will be completed for electric operation by June, 1915. Eighteen locomotives will be required.

Oven for Drying Paint on Cars.

In order to save as much time as possible in the paint shop of the Detroit United Railways an oven has been installed, large enough to accommodate the biggest car, to dry the paint so that only 7 or 8 days is required to put the car through the paint shop, whereas formerly 15 to 18 days were required.

The heat in the oven, constructed with two walls, the outer of matched lumber, and the inner of corrugated iron with an intervening air space, is obtained from electric heaters placed on either side and near the floor. Ventilation is provided so that fresh warm air is in the oven at all times. The temperature is not raised high enough to bake the paint, but simply to facilitate its drying through rapid evaporation and the carrying away of gases and fumes from the paint and varnish. A temperature of approximately 90 deg. gives the best results.

Another Application of Wireless.

Experiments were conducted in Leghorn, Italy, to show the practicability of setting off mines by wireless from a distance of half a mile. The mines were submerged in the sea about 450 feet from the shore and 100 feet apart. The mines were exploded separately with an intervening period of about two seconds, without any interference from other wireless stations in the neighborhood.

Long-Distance Radiotelegraphy.

Messages sent out from the wireless station at Nauen, Germany, have been detected 5,600 miles distant in the South Atlantic Ocean, and at night time have been received without difficulty 4,300 miles. More than half of this distance was over the land areas of Europe and Africa.

Tried to Pass Law Prohibiting Rate Cutting.

We hear so much these days about the demand of railroads for increase of rates that it seems strange to reflect upon a time when State legislatures were trying to prohibit the cutting of rates.

An article that appeared in this paper in 1889 reads: "A bill has been introduced into the Wisconsin legislature that is intended to prevent rate cutting. It provides that rates shall never be raised; that the lowest rate reached during a cut shall become the fixed rate for the service until another cut shall be made. At first thought this looks as if it might prevent some of the ruinous cuts that do so much harm to the roads, preventing them from paying dividends, crowding the lines with traffic one month, and causing a cut in wages and a reduction of the men employed the next. Rate cutting is a menace to the safety of every employee on the road, cuts his pay, busts the company, and stagnates the business of the country."

The railroad managers who persisted in rate cutting left a legacy of disaster to those of the present day.

A pair of Irishmen secured a job cutting ice on a lake in New Jersey. They received a cross-cut saw to do the cutting and proceeded together to the scene of operations. "This is a fine job we've got," remarked Pat to his companion as they approached the ice; "three dollars a day and easy work, but I'm puzzled about who will push the end of the saw under the water."

Items of Personal Interest

Mr. A. Helbrecht has been appointed locomotive foreman of the Chicago Great Western, at Hayfield, Minn.

Mr. E. L. Fries has been appointed general storekeeper on the Union Pacific, with office at Omaha, Neb.

Mr. F. E. Botsford has been appointed car foreman on the Chicago, Great Western, at St. Joseph, Mo.

Mr. W. Wells has been appointed general foreman of the Canadian Pacific, at McAdam Junction, N. B.

Mr. F. Johnson has been appointed night locomotive foreman of the Canadian Pacific, at North Transcona, Man.

Mr. B. Wood has been appointed master mechanic of the Oneida and Western, with office at Oneida, Tenn.

Mr. W. J. King has been appointed locomotive foreman of the Central Vermont at White River Junction, Vt.

Mr. D. D. Cossar has been appointed locomotive foreman on the Canadian Pacific, with office at Moose Jaw, Sask., Canada.

Mr. A. F. Dorley has been appointed principal assistant engineer of the Missouri Pacific, with headquarters at St. Louis, Mo.

Mr. George W. Hand has been appointed valuation engineer on the Chicago & North Western, with office at Chicago, Ill.

Mr. R. H. Hallstead has been appointed assistant engineer on the Missouri Pacific, with headquarters at Kansas City, Mo.

Mr. R. H. Hunter has been appointed traveling engineer on the Oregon Short Line, with headquarters at Glenns Ferry, Idaho.

Mr. W. F. Heinbach has been appointed enginehouse foreman of the Philadelphia & Reading, at East Penn Junction, Pa.

Mr. J. Pfeiffer has been appointed master mechanic of the Chicago, Burlington and Quincy, with office at Centerville, Ia.

Mr. David Grattan has been appointed master mechanic on the Oregon Short Line, with headquarters at Pocatello, Idaho.

Mr. Wm. Pohlaman has been appointed locomotive shop foreman of the New York, Ontario and Western at Middletown, N. Y.

Mr. O. H. Binns has been appointed district master mechanic of the Canadian Pacific, with headquarters at West Toronto, Ont.

Mr. G. F. Schroeder has been appointed day roundhouse foreman of the Chicago, Rock Island & Pacific, with office at Manly, Iowa.

Mr. R. C. Cross, locomotive foreman on the Chicago, Great Western, has been transferred from Hayfield, Minn., to Minneapolis, Minn.

Mr. D. J. Malone, master mechanic of the Oregon Short Line R. R., at Ogden, Utah, has removed his headquarters to Pocatello, Idaho.

Mr. F. C. Balus has been appointed engineer of bridges and buildings on the Duluth, Missabe & Nutten, with headquarters at Duluth, Minn.

Mr. Stephen C. Mason, secretary of the McConway & Torley Company, has been appointed an executive member of the Railway Business Association.

Mr. Dudley O. Johnson has been appointed branch manager of the Chicago office of the Joseph Dixon Crucible Company, succeeding the late Mr. Sam Mayer.

Mr. Walter N. Polakow has been appointed supervisor of power plants on the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

Mr. F. L. Willis, formerly assistant locomotive foreman, has been appointed locomotive foreman of the Canadian Pacific, with office at McAdam Junction, N. B.

Mr. A. J. Pentland, formerly day roundhouse foreman of the Canadian Pacific at Swift Current, Sask., has been appointed locomotive foreman at Ignace, Ont.

Mr. W. Watman, formerly gang foreman of the Canadian Pacific at Winnipeg, Man., has been appointed erecting foreman on the same road with office at Vancouver, B. C.

Mr. Wm. Fenwick, general foreman of the Wheeling and Lake Erie, at Canton, Ohio, has been transferred to a similar position on the same road at Brewster, Ohio.

Mr. C. H. Holdredge, road foreman of engines on the Southern Pacific, at Tucson, Ariz., has been transferred to a similar position on the same road at San Francisco, Cal.

Mr. David Hickey, master mechanic and assistant division superintendent of the Southern Pacific Co., at Sparks, Nev., has been appointed master mechanic at Ogden, Utah.

Mr. J. M. Hall, locomotive boiler inspector for District 28, of the Interstate Commerce Commission, has been transferred to District No. 9, with headquarters at Philadelphia, Pa.

Mr. A. C. Hinckley, superintendent of motive power and machinery of the Oregon Short Line, has moved his office from Salt Lake City, Utah, to Pocatello, Idaho.

Mr. W. G. Willcoxon has been appointed representative in the railway department of the Garratt-Callahan Company, with office at 27 South Clinton street, Chicago, Ill.

Mr. C. H. McCormack has been promoted to the position of vice-president of the Standard Heat & Ventilating Company, with office at 1949 Peoples Gas Building, Chicago, Ill.

Mr. A. Sturrock, formerly erecting foreman of the Canadian Pacific at Vancouver, B. C., has been appointed general foreman on the same road at Ogden shops, Calgary, Alta.

Mr. George C. Isbester, for several years employed in the New York office of the Rail Joint Company, has been appointed to take charge of the Chicago office at 215 Exchange building.

Mr. E. C. Sasser has been promoted to the position of superintendent of motive power for the Northern and Eastern districts of the Southern, with headquarters at Washington, D. C.

Mr. J. G. Schepp has been appointed master mechanic of the Texas and Pacific, at Texarkana, Texas, and Mr. J. A. Carleston, general foreman of the locomotive department on the same road at Marshall, Tex.

Mr. J. A. Power has been appointed shop superintendent of the Houston and Texas Central, and Mr. L. F. Breaker has been appointed general foreman on the same road, both with offices at Houston, Tex.

Mr. E. A. Sweeley, formerly supervisor of car repairs of the Atlantic Coast Line, has been appointed master car builder of the Seaboard Air Line, with headquarters at Portsmouth, Va. foreman in place of Mr. Horan.

Mr. Thos. McFarlane has been appointed traveling engineer on the Chicago, Milwaukee & St. Paul, at Ellensburg, Wash., and Mr. W. Voss has been appointed traveling engineer on the same road at Lewistown, Mont.

Mr. L. L. Moebeck has been appointed road foreman of engines of the Northern Pacific at East Grand Forks, Minn., and Mr. M. Sidney has been appointed road foreman of engines on the same road at Duluth, Minn.

Mr George H. Hansel has organized the Railroad Valuation Company, with offices at 25 Broad street, New York. Associated with this company are en-

gineers, analysts and accountants of wide experience and experts in valuation work.

Mr. R. L. Stewart has been appointed mechanical superintendent of the Chicago, Rock Island and Pacific, with headquarters at El Reno, Okla., and Mr. W. M. Wilson has been appointed master mechanic on the same road with office at Dalhart, Tex.

Mr. Ralph W. Perry, formerly chemist and engineer of tests for the Michigan Central, has severed his connection with the railway company and has established the Perry Laboratory, for conducting a general chemical, inspecting and testing business.

Mr. D. F. Kirkland has been appointed general manager of the Georgia & Florida. He began railway service as a bridge laborer on the South Florida. He has filled almost every position in the transportation department on a number of southern railways.

Mr. F. B. Fisher has been appointed master mechanic of the Central New England with office at Hartford, Conn., and Mr. J. E. Dougherty has been appointed traveling engineer on the same road with headquarters at Poughkeepsie, N. Y.

Mr. Robert Collett, formerly superintendent of locomotive performance of the St. Louis and San Francisco, has resigned and accepted the position of assistant manager of the railroad department for the Pierce Oil Corporation with office at St. Louis, Mo.

Mr. W. D. Jenkins, formerly private secretary to Judge Freeman, general counsel of the Texas & Pacific, has been appointed southern representative of the Union Railway Equipment Company, Chicago, Ill., with office in the Whieney Central building, New Orleans, La.

Mr. John Horan, road foreman of the Northern Pacific Ry., at Minneapolis, Minn., has been appointed acting master mechanic at that place, succeeding J. B. Neish, who has been granted leave of absence. R. E. Hammond has been appointed acting road foreman in place of Mr. Horan.

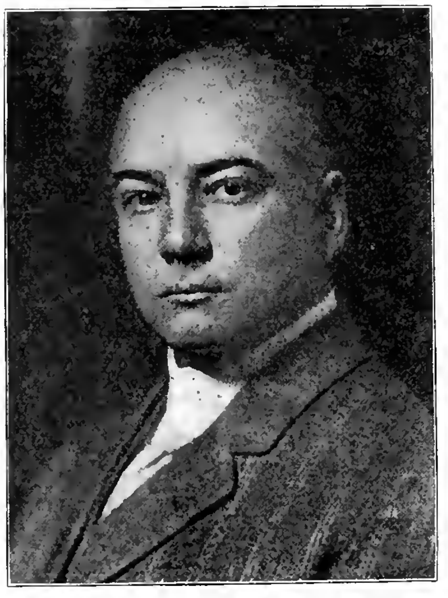
Mr. J. W. Williams, assistant chief engineer of the Northwestern Pacific, has been appointed chief engineer of construction, succeeding William C. Edes, resigned, and F. K. Zook, engineer maintenance of way, has been appointed chief engineer maintenance and structural engineer, both with headquarters at San Francisco, Cal.

Mr. E. Hartenstein has been appointed traveling engineer for the Northern district of the Chicago and Alton, with headquarters at Bloomington, Ill. Mr. Hartenstein was formerly with the Westinghouse Air Brake Co., located at Chicago office, and assigned to territory west of Chicago, Ill.

Mr. John C. Neale, formerly assistant general business manager of sales of the Carnegie Steel Company, has resigned to become president of the Central Steel Company, Massillon, Ohio, and Mr. John W. Dix has been appointed assistant general manager of sales and structural engineer of the Carnegie Steel Company, with office at Pittsburgh, Pa.

Mr. W. H. Finley has been appointed chief engineer on the Chicago & Northwestern, with headquarters at Chicago, Ill. Mr. Finley has filled many important positions on some of the principal western railroads. He was for several years attached to the bridge and building department of the Chicago, Milwaukee & St. Paul. On the Chicago & North Western he filled successively the positions of engineer of bridges, principal assistant engineer, and assistant chief engineer.

Mr. John L. Mohun, formerly in the motive power department of the Pennsylvania, has been appointed assistant to the consulting engineer of the Union



ALBERT J. STONE.

Pacific, the Oregon Short Line and the Oregon-Washington Railroad & Navigation Company, with headquarters in New York. Mr. Mohun served his apprenticeship as a machinist in the Altoona shops of the Pennsylvania, and was rapidly promoted, serving as master mechanic of the Juniata shops, and latterly as master mechanic and assistant engineer of motive power at Jersey City, N. J.

Mr. Albert J. Stone, general manager of the Erie, at New York, has been elected vice-president in charge of the operating department. Mr. Stone was born at Holly, Mich., 1873. Educated at Hornell High School, Hornell, N. Y., and the Elmira Business College, at Elmira, N. Y. He entered railway service in 1888 as messenger on the New York, Lake Erie and Western, and remained with the road and its successor the Erie, in various positions in the operating department until 1902, when he became assistant to the general manager. In 1903 Mr. Stone entered the service of the Delaware and Hudson company as general superintendent. In 1905 he was appointed assistant general manager of the Erie and its controlled lines, and in 1907 he became general superintendent of the same road, until January, 1913, when he was appointed general manager.

Mr. Stone has risen very rapidly in the railroad world and, of course, his success has not been due to accident. Mr. Stone's conspicuous strength has been fine executive ability and his skill in managing men. The latter characteristic comes from his high sense of justice which demands fairness all around when any cause for friction arises. Mr. Stone represents the finest type of modern railroad official actuated by the desire to hold men to the performance of duty under the fairest kind of treatment.

Pennsylvania Pensioners.

Forty-five employes of the Pennsylvania Railroad have just been retired under the pension rules of the company. Two of them have been in the company's service over 52 years, while 20 of them have worked for the railroad 40 years or longer.

H. O. Hukill, purchasing agent of the Pennsylvania lines West of Pittsburgh, served the company 54 years and 2 months. He was employed by the railroad in March, 1860, as messenger.

Joseph Brudon, motorman on the West Jersey & Seashore Railroad, also served the railroad 53 years and 3 months.

In the first six months of 1914 the Pennsylvania Railroad placed 349 employes on the pension roll—Roll of Honor, it is called. Nineteen of these railroad men had worked for the railroad more than 50 years, while 174 had been in its active service more than 40 years.

Since the Pennsylvania Railroad's retirement plan was established on January 1, 1900, the railroad has paid out of its treasury in pensions to its employes $10,017,978.48, and 8,093 have been placed on the company's roll of honor; 3,957 of these have died, so that there are to-day on the railroad roll of honor 4,136 employes.

Committee for 1915 Master Mechanics' Convention.

The Executive Committee of the Railway Master Mechanics' Association met in the Karpen Building, Chicago, and transacted a large volume of routine business arranged by Secretary Taylor, among the most important being the decision on committees to report at next

year's convention and appointing the personnel of the committees. Following are the subjects and the members appointed to deal with them:

STANDING COMMITTEES.

1. REVISION OF STANDARDS AND RECOMMENDED PRACTICE.—W. E. Dunham (chairman), S. M. P. & M., C. & N. W. Ry., Winona, Minn.; A. R. Ayers, G. M. E., New York Central Lines, Chicago, Ill.; M. H. Haig, M. E., A. T. & S. F. Ry., Topeka, Kan.; A. G. Trumbull, M. S., Erie R. R., Jersey City, N. J.; C. D. Young, engineer tests, Pennsylvania R. R., Altoona, Pa.

2. MECHANICAL STOKERS.—A. Kearney (chairman), A. S. M. P., N. & W. Ry., Roanoke, Va.; M. A. Kinney, S. M. P., Hocking Valley R. R., Columbus, Ohio; J. R. Gould, S. M. P., C. & O. Ry., Richmond, Va.; T. R. Cook, A. E. M. P., Pennsylvania Lines, Pittsburgh, Pa.; J. T. Carroll, A. G. S. M. P., Baltimore & Ohio R. R., Baltimore, Md.; J. W. Cyr, S. M. P., C. B. & Q. Ry., Chicago, Ill.; A. J. Fries, A. S. M. P., New York Central Lines, Depew, N. Y.

3. SMOKE PREVENTION.—E. W. Pratt (chairman), A. S. M. P., C. & N. W. Ry., Chicago, Ill.; J. F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; W. C. Hayes, S. L. O., Erie R. R., New York City; T. R. Cook, A. E. M. P., Pennsylvania Lines, Pittsburgh, Pa.; Jos. Chidley, A. S. M. P., L. S. & M. S. Ry., Cleveland, Ohio; A. G. Kantmann, S. M., N. C. & St. L. Ry., Nashville, Tenn.; W. J. Tollerton, G. M. S., C. R. I. & P. Ry., Chicago, Ill.

4. FUEL ECONOMY.—William Schlafge (chairman), G. M. S., Erie R. R., New York City; W. H. Flynn, S. M. P., Michigan Central, Detroit, Mich.; D. M. Perine, S. M. P., Pennsylvania R. R., New York City; Robert Quayle, S. M. P., C. & N. W. Ry., Chicago, Ill.; S. G. Thomson, S. M. P. & R. E., Philadelphia & Reading R. R., Reading, Pa.; D. J. Redding, A. S. M. P., P. & L. E. R. R., McKees Rocks, Pa.

SPECIAL COMMITTEES.

5. DESIGN, CONSTRUCTION AND INSPECTION OF LOCOMOTIVE BOILERS.—C. E. Fuller (chairman), S. M. P., Union Pacific R. R., Omaha, Neb.; A. W. Gibbs, C. M. E., Pennsylvania R. R., Philadelphia, Pa.; D. R. MacBain, S. M. P., Lake Shore & Michigan Southern Ry., Cleveland, Ohio; M. K. Barnum, G. M. I., B. & O. R. R., Baltimore, Md.; R. E. Smith, G. S. M. P., Atlantic Coast Line R. R., Wilmington, N. C.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.; J. Snowden Bell, New York City.

6. JOINT MEETINGS, A. R. M. M. ASS'N AND M. C. B. ASS'N.—From the Master Mechanics' Association—J. F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; C. E. Chambers, S. M. P., C. R. R. of N. J., Jersey City, N. J.; C. F. Giles, S. M., Louisville & Nashville R. R., Louisville, Ky.; from the Master Car Builders' Association—R. W. Burnett, G. M. C. B., Canadian Pacific Ry., Montreal, Can.; J. S. Lentz, M. C. B., L. V. R. R., S. Bethlehem, Pa.; T. H. Goodnow, A. S. C. D., C. & N. W. Ry., Chicago, Ill.

7. LOCOMOTIVE HEADLIGHTS. — D. F. Crawford (chairman), G. S. M. P., Pennsylvania Lines, Pittsburgh, Pa.; A. R. Ayers, G. M. E., New York Central Lines, Chicago, Ill.; C. H. Rae, G. M. M., L. & N. Ry., Louisville, Ky.; F. A. Torrey, G. S. M. P., C. B. & Q. Ry., Chicago, Ill.; H. T. Bentley, P. A. S. M. P., C. & N. W. Ry., Chicago, Ill.; M. K. Barnum, G. M. I., Baltimore & Ohio R. R., Baltimore, Md.; Henry Bartlett, G. M. S., B. & M. R. R., Boston, Mass.

8. SAFETY APPLIANCES.—F. F. Gaines (chairman), S. M. P., Central of Georgia Ry., Savannah, Ga.; M. K. Barnum, G. M. I., Baltimore & Ohio R. R., Baltimore, Md.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.

9. STANDARDIZATION OF TINWARE.—M. D. Franey (chairman), M. M., L. S. & M. S. Ry., Elkhart, Ind.; J. C. Mengel, M. M., Pennsylvania R. R., Altoona, Pa.; W. C. Hayes, S. L. O., Erie R. R., New York City; G. S. Goodwin, M. E., C. R. I. & P. Ry., Chicago, Ill.; W. C. Moody, M. E., Illinois Central R. R., Chicago, Ill.

10. SUPERHEATER LOCOMOTIVES.—H. H. Vaughan (chairman), A. V. P., Canadian Pacific Ry., Montreal, Can.; H. W. Coddington, engineer tests, N. & W. Ry., Roanoke, Va.; C. H. Hogan, A. S. M. P., N. Y. C. & H. R. R. R., Albany, N. Y.; R. W. Bell, G. S. M. P., Illinois Central R. R., Chicago, Ill.; T. Roope, S. M. P., C. B. & Q. R. R., Lincoln, Neb.; W. J. Tollerton, G. M. S., C. R. I. & P. Ry., Chicago, Ill.; W. C. A. Henry, S. M. P., Pennsylvania Lines, Columbus, Ohio.

11. LOCOMOTIVE COUNTERBALANCING.—A. W. Gibbs, C. M. E., Pennsylvania R. R., Philadelphia, Pa.; S. M. Vauclain, V. P. Baldwin Locomotive Works, Philadelphia, Pa.; F. J. Cole, C. C. E., American Locomotive Co., Schenectady, N. Y.; John Purcell, assistant to president, A. T. & S. F. Ry., Chicago, Ill.; W. H. V. Rosing, assistant to chief operating officer, St. L. & S. F. Ry., Springfield, Mo.; O. C. Cromwell, M. E., Baltimore & Ohio R. R., Baltimore, Md.; T. W. Heintzelman, G. S. M. P., Southern Pacific Co., San Francisco, Cal.

12. MAINTENANCE AND OPERATION OF ELECTRICAL EQUIPMENT.—C. H. Quereau (chairman), N. Y. C. & H. R. R. R., New York City; G. C. Bishop, S. M. P., Long Island R. R., Richmond Hill, N. Y.; G. W. Wildin, M. S., N. Y., N. H. & H. R. R., New Haven, Conn.; J. H. Davis, electrical engineer, Baltimore & Ohio R. R., Baltimore, Md.; R. D. Hawkins, S. M. P., Great Northern Ry., St. Paul, Minn.

13. Joint Committee to co-operate with committee of Master Car Builders and of Air Brake Associatioon. Members not appointed.

14. REVISION OF AIR BRAKE AND TRAIN SIGNAL INSTRUCTIONS.—R. B. Kendig (chairman), New York Central Lines, New York City; J. M. Henry, S. M. P., Pennsylvania R. R., Pittsburgh, Pa.; B. P. Flory, S. M. P., N. Y., O. & W. Ry., Middletown, N. Y.; L. P. Streeter, air brake inspector, Illinois Central R. R., Chicago, Ill.; A. J. Cota, M. M., C. B. & Q. R. R., Chicago, Ill.; T. L. Burton, Westinghouse Air Brake Co., Wilmerding, Pa.; W. J. Hartman, air brake inspector, C. R. I. & P. Ry., Chicago, Ill.

15. TRAIN RESISTANCE AND TONNAGE RATING.—P. E. Smith, Jr. (chairman), S. M. P., Pennsylvania Lines, Toledo, Ohio; W. E. Dunham, S. M. P. & M., C. & N. W. Ry., Winona, Minn.; J. S. Sheafe, M. M., B. & O. R. R., Staten Island, N. Y.; H. C. Manchester, S. M. P., D., L. & W. R. R., Scranton, Pa.; C. E. Chambers, S. M. P., C. R. R. of N. J., Jersey City, N. J.; J. H. Manning, S. M. P., D. & H. Co., Watervliet, N. Y.; Frank Zeleny, engineer tests, C. B. & Q. R. R., Aurora, Ill.

16. BOILER WASHING.—John Purcell (chairman), assistant to president, A., T. & S. Fe Ry., Chicago, Ill.; W. H. Fetner, M. M., Central of Georgia Ry., Macon, Ga.; J. C. Little, M. E., C. & N. W. Ry., Chicago, Ill.; G. W. Rink, M. E., C. R. R. of N. J., Jersey City, N. J.; W. P. Carroll, M. M., New York Central Lines, Rochester, N. Y.; E. S. Fitzsimmons, M. S., Erie R. R., Cleveland, Ohio; G. E. Sisco, A. E. M. P., Pennsylvania Lines, Columbus, Ohio.

17. DIMENSIONS OF FLANGE AND SCREW COUPLINGS FOR INJECTORS.—O. M. Foster (chairman), M. M., L. S. & M. S. Ry., Collinwood, Ohio; T. F. Barton, M. M., D., L. & W. R. R., Kingsland, N. J.; M. H. Haig, M. E., A., T. & S. Fe Ry., Topeka, Kan.; W. Alexander, M. M., C. M. & St. P. Ry., Milwaukee, Wis.; W. W. Winterrowd, M. E., Canadian Pacific Ry., Montreal, Can.

18. SUBJECTS.—A. W. Gibbs (chairman), C. M. E., Pennsylvania R. R., Philadelphia, Pa.; D. R. MacBain, S. M. P., L. S. & M. S. Ry., Cleveland, Ohio; C. E. Fuller, S. M. P., Union Pacific R. R., Omaha, Neb.

19. ARRANGEMENTS. — F. F. Gaines (chairman), S. M. P., Central of Georgia Ry., Savannah, Ga.; D. F. Crawford, G. S. M. P., Pennsylvania Lines West, Pittsburgh, Pa.; J. Will Johnson, Pyle-National Electric Headlight Co., Chicago, Ill.

INDIVIDUAL PAPERS.

ALLOY STEEL.—S. M. Vauclain, V. P., Baldwin Locomotive Works, Philadelphia, Pa.

VARIABLE EXHAUSTS.—J. Snowden Bell, New York City.

RAILROAD NOTES.

The Pennsylvania will build 1,000 steel box cars at its Altoona shops.

The Denver & Rio Grande is reported in the market for 15,000 tons of rails.

The Buffalo, Rochester & Pittsburgh is in the market for ten caboose cars.

The Southern Pacific's inquiry is for 20 Mikado and 10 switching locomotives.

The Intercolonial has ordered three switchers from the Montreal Locomotive Works.

The Erie has ordered five Pacific locomotives from the Baldwin Locomotive Works.

The Delaware, Lackawanna & Western is in the market for 500 steel underframe box cars.

The Southern has ordered 15,000 tons of rails from the Tennessee Coal, Iron & Railroad Co.

The Chicago, Indianapolis & Louisville is reported in the market for 250 40-ton box cars.

The Pennsylvania has placed orders for 100,000 tons of steel rails with various companies.

The Pittsburgh Shawmut & Northern has ordered 1,500 tons of rails from the Carnegie Steel Co.

The Canadian Pacific has ordered ten locomotives from the Montreal Locomotive Works.

The Russian Government is asking prices on a large number of locomotives of various types.

The Delaware, Lackawanna & Western has ordered 200 mine cars from the Magor Car Company.

The Atlantic Coast Line is in the market for a number of Mountain and Pacific type locomotives.

The Canadian Northern has placed an order for eight passenger cars with the Pressed Steel Car Co.

The Pittsburgh & Shawmut has ordered six Mikado locomotives from the Baldwin Locomotive Works.

The Canadian Northern has placed an order for passenger cars with the Canadian Car & Foundry Co.

The Chicago Elevated Railways have placed an order for 122 all steel cars with the Cincinnati Car Company.

The Missouri Pacific has placed an order for 4,700 tons of rails with the Tennessee Coal, Iron & Railroad Co.

Winston Brothers Company, Minneapolis, Minn., are in the market for 8 or 10 six-wheel switching locomotives.

The Chicago, Milwaukee & St. Paul has ordered five Mikado locomotives from the American Locomotive Company.

The Pittsburg, Shawmut & Northern has ordered 25 refrigerator cars from the American Car & Foundry Company.

The Chicago, Burlington & Quincy has ordered 15 Santa Fe type locomotives from the Baldwin Locomotive Works.

The Intercolonial Railway of Canada is in the market for 8 all-steel sleeping cars and one all-steel compartment observation car.

The Northwestern Pacific is in the market for 4 ten-wheel passenger, 2 ten-wheel freight and 3 six-wheel switching locomotives.

The Chilean State Railways are proposing the purchase of 125 locomotives as part of a plan for the rehabilitation of the railways of Chile.

The Canadian Northern is reported to be planning an expenditure of $10,000,000 in Alberta for carrying out construction program this year.

The Green Bay & Western has ordered one mogul locomotive from the American Locomotive Co. It will be equipped with a superheater.

Chicago & Illinois Midland Ry. has placed an order for 250 50-ton drop-bottom steel gondola cars with the American Car & Foundry Co.

The contract for the new union station and terminals at Dallas, Tex., has been let to John W. Thompson, St. Louis, Mo., at about $3,000,000.

The Pennsylvania is proceeding with the construction of 84 locomotives at the Altoona shops, the remainder of its 1914 provision for motive power equipment.

The Illinois Central is in the market for 50 Mikado type and a number of Pacific type locomotives, and for a

number of locomotives for hump-yard service.

The Southern Pacific is in the market for 2,600 50-ton box cars, 400 50-ton flat cars, 850 40-ton single deck stock cars, 250 50-ton gondola cars, 300 50-ton tank cars and 20 caboose cars.

The Bangor & Aroostook has ordered 5 superheater Consolidation locomotives from the American Locomotive Company. These locomotives will have 23 by 30 in. cylinders, 56 in. driving wheels, a total weight in working order of 213,000 lb., and a steam pressure of 175 lb.

The Chicago, Burlington & Quincy has improvements now under way in the yards, outside of St. Paul, Minn., which include the filling of 14 acres of marsh land, the extension of the present tracks to a length of 4,500 feet, the construction of 5 new tracks, a coach ward and 2 new switching leads. There will also be erected a 12-stall roundhouse, a large transfer platform and a steel water tank with a capacity of 100,000 gallons.

The Southern Pacific has ordered 20 superheater Mikado type passenger and 10 superheater switching locomotives from Lima Locomotive Corporation. The Mikado locomotives will have 26 by 28 in. cylinders, 63 in. diameter driving wheels, a weight on the driving wheels of 218,000 lb. and a total weight in working order of 305,000 lb. The switching locomotives will have 19 by 26 in. cylinders, 51 in. diameter driving wheels and a total weight in working order of 155,000 lb. Both the Mikado and switching locomotives will be equipped for oil burning.

Pennsylvania's Grain Elevator.

The Pennsylvania Railroad has placed in operation its new 1,100,000 bushel grain elevator at Girard Point, Philadelphia.

The new elevator was built at a cost of $1,200,000. It is made entirely of concrete and steel, and the facilities it affords represent the last word in scientific practice. It is expected to prove the most rapid plant ever built for transferring grain from rail to water.

The elevator proper sits back 500 feet from a pier 900 feet long, on both sides of which vessels can dock. Grain will be delivered to ships for export by a conveying gallery, which extends out to the end of the pier.

The elevator has an unloading capacity of 240 cars per day of ten hours. It has sufficient trackage to accommodate 400 cars. The capacity and flexibility of the receiving and shipping plant is further increased by a six-track concrete shed, two cars long, permitting the unloading of twelve cars at once. The shipping gallery has a capacity for loading ocean steamers of 650 feet length, at the rate of 60,000 bushels per hour.

In general the elevator plant consists of a working house for the machinery, track shed, storage house or annex, and conveyor gallery, pier, power house and drier. Grain is received in the track shed receiving pits, and after unloading is carried to one of four receiving elevator legs and elevated to the garner over a receiving scale, from where, after weighing, it is spouted to bins in the working house for cleaning or shipment to vessels, or is carried on a conveyor belt to the annex for storage. Shipping facilities to vessels are provided by four belt conveyors from the working house to the pier.

The new elevator is equipped with one of the largest grain driers in the country. It has a capacity of 3,000 bushels per hour. The plant also has the four largest grain cleaning machines in the country; 20,000 bushels can be cleaned in one hour.

To the east of the working house and connected to it by a concrete tunnel and bridge is the storage annex, with a capacity of more than 800,000 bushels.

Testing the Erie Triplex Compound.

On Friday, July 24, a special test of the new mammoth Erie Triplex Compound locomotive was made on the Erie Railroad at Binghamton, N. Y. As already described in the May issue of RAILWAY AND LOCOMOTIVE ENGINEERING the locomotive is a new departure in steam engine construction, being furnished with twenty-four driving wheels, one set of drivers being placed under the tender, the locomotive weighing 410 tons.

The officers in charge kept adding car after car of coal to the train until it consisted of 250 fully-loaded steel "battleships," with a total weight of 21,000 tons. The locomotive pulled this train for 40 miles at the rate of 15 miles an hour. The train was 10,000 tons heavier than any ever pulled by a locomotive.

Hardness of Woods.

Woods are going rapidly out of fashion in railroad car construction, when only a few brief years ago they formed the entire structure of cars.

The relative hardness of woods is calculated from hickory which is the toughest and hardest wood in popular use. Estimating hickory at 100, we get for white oak, 84; white ash, 77; dog wood, 74; scrub oak, 73; white hazel, 72; apple, 70; red oak, 69; white birch, 65; black walnut, 65; black birch, 62; yellow and black oak, 60; hard maple, 56; white elm, 58; cedar, 56; cherry, 55; yellow pine, 53; chestnut, 52; yellow poplar, 51.

Books, Bulletins, Catalogues, Etc.

Proceedings of the 21st Annual Convention of the Air Brake Association.

The proceedings of the Air Brake Association at the annual convention, held in Detroit, Mich., last May, are already published in a substantial volume of over 300 pages and elegantly bound in flexible leather. It is much to the credit of the association that the volume containing a full reproduction of the many papers and reports submitted and the interesting debates thereon are already in book form. The Air Brake officials know how to keep up the pressure and do not relax into inactivity after the annual meeting is over. The book amply sustains the high character of the membership, and all who desire to keep abreast of air brake practice would do well and act wisely to secure a copy of the work. The illustrations, although not numerous, are of real value, and enhance the merit of the publication. Copies may be had from the secretary, Mr. F. M. Nellis, 53 State street, Boston, Mass.

Useful Information About North Pacific Ports.

The Terminal Facilities of North Pacific Ports is the title of a volume which has just been issued by the Terminal Publishing Co., Seattle. It covers the principal ports from San Diego on the south to Nome on the north. The regulations governing these ports are given in full, and all charges that are assessed against either the ship or the cargo are included. The names and addresses of government officials, foreign consuls and others in each port, whose names and addresses are of value to masters and shippers, are given. One section is devoted to the depth of water in all the bays and inlets on the United States coast. The customs, marine insurance, immigration regulations and matters of that sort are set forth in detail.

There are scores of tables in the work. The money of all foreign countries is reduced to its Canadian and United States equivalent and foreign weights are reduced to avoirdupois pounds. One remarkably useful table which is included and which is here published for the first time gives at a glance the amount of freight due on any shipment that is paid by its cubic measurement. With this book at his elbow a transportation man need waste no more time in figuring out rates. To find the cost of 17 cubic feet at $23 per ton entails no more labor than running a pencil along a line and copying down the figures.

The Terminal Facilities of North Pacific Ports retails for $2 per volume and will be published annually, by the Terminal Publishing Co., Seattle, Wash.

Heat Treating Furnaces.

Tate-Jones & Company, Pittsburgh, Pa., has just issued a finely illustrated catalogue of 32 pages on the subject of annealing, hardening and tempering of steel, and all heat treating operations. It is the latest word on the scientific management of steel. The various designs of the furnaces have been perfected by engineers of recognized ability in this special field, and every problem that could possibly arise has been foreseen and provided for, and the prolonged tests of daily use have shown the furnaces to be economical and efficient. The semi-muffle furnaces for annealing and general hardening with oil or gas fuel are a new and admirable departure in furnace appliances and are coming rapidly into popular favor. Various types of portable furnaces are also described and these are particularly suited for establishments that are too small to equip these plants with the larger types. Equally important are the new types of crucible furnaces with hardening both for high speed and carbon steels. A table of annealing temperatures recommended by the American Society for Testing Materials is added, and altogether the catalogue is the best yet issued by the enterprising firm. Copies may be had on application to the company's office at Pittsburgh.

Link Motions, Valve Gears and Valve Setting.

A third edition, revised and enlarged, of this popular handbook, by Fred. H. Colvin, the well-known engineering writer, has just been issued by the Norman W. Henley Publishing Company, 132 Nassau street, New York. Price 50 cents. This is one of the few engineering books that have stood the test of time and has remained a favorite among practical railway men. The successive and extensive editions have been revised and brought up to date to meet the growing requirements that have arisen from the introduction of new valve gears, and the adoption of new forms of valve gearing that are slowly but surely revolutionizing the harnessing of steam in its application to the modern locomotives. The book has the genuine merits of simplicity and directness. It begins at the beginning, and the student is led by easy stages to a complete mastery of the details of the various valve motions described. And all this is done without the use of involved mathematical problems or unnecessary scientific nomenclature. The book is severely practical, and there are just enough illustrations to render the work intelligible to the reader who may not have any previous familiarity with the subjects, and at the same time admirably

suited to those who may have some superficial knowledge of the important subjects treated. That the book will continue to be a favorite, especially among the younger railway men, is a foregone conclusion. The earlier and elemental features are retained and the new additions amply sustain the original merits of the work.

The Wonders of Utah.

Among the numerous bulletins issued by railway companies and others, the Salt Lake City Passenger Association has issued a unique folder describing and illustrating the wonders of Utah, which cannot fail to attract wide attention. Of course, the traveling public are looking for something new all the time, and the enterprising railway men are on the job to meet the demand. In Utah they have America's Dead Sea so impregnated with solids that you cannot sink. Then the Mormon Temple and Tabernacle, with its unrivalled pipe organ that shakes the earth. Then there are copper mines where one thousand tons of copper are dragged out of the lower regions every hour of the day. Then the canyons, waterfalls and kaleidoscopic panorama of nature in all the gorgeous glow of rainbow hues dazzle the beholder. All this and more than this are within easy reach of Salt Lake City. Mr. J. S. Earley, secretary of the Passenger Association, will send fuller details on application and a copy of the interesting folder.

Malleable Iron Coal Picks.

The malleable iron coal picks manufactured by the National Malleable Castings Company, Cleveland, Ohio, are universally acknowledged to have no superior for use in locomotive tenders, and have shown their utility for a great many years in many of the largest railroads in America. The picks are made of high grade malleable iron, are carefully designed, neat in appearance, and last indefinitely. They are much more reliable than cast iron, and are cheaper than forged steel, and can at all times be depended upon. A new circular, No. 67, has just been issued by the company and copies may be had from the main office or at any of the branch offices at Chicago, Indianapolis or Toledo.

Tate Flexible Staybolts and Tools.

The Flannery Bolt Company, Vanadium Building, Pittsburgh, Pa., have published their catalogue illustrating and describing staybolts and tools for the installation of the same. This publication supersedes previous issues, and extends to 30 pages of letterpress with 64 illustrations. Of particular interest is the full and clear description of the tools for installing the staybolts. It is hardly necessary to repeat the fact that the service records of the Tate flexible staybolt over a period of more than ten years on nearly all railroads testify to the economic results obtained, compared to the service of the rigid staybolt. Long experience has shown that the earlier designs of flexible staybolts contained some errors which have been remedied in the later designs, and the staybolt has now been reduced to a simple, strong and serviceable factor in locomotive boiler construction overcoming all weakness and errors in past design. The revised catalogue contains full particulars in regard to the latest designs and tools for applying such, and copies of the catalogue for 1914 may be had on application to the company's office.

Lock Couplers and Packless Valves.

The Gold Car Heating & Lighting Company, 17 Battery Place, New York, is constantly adding to its stock of railway appliances. Among the more recent is a positive lock coupler which shows several marked improvements, especially in a safety device which prevents freezing and scalding of employees. A gravity safety trap drains condensed steam, and entirely prevents freezing of hose on train line. It is lighter in weight than the older styles and consequently causes less wear on the hose, and dry steam is assured at all times. The number of gaskets is also reduced. It is easily handled and will couple perfectly with all makes, and only needs to be seen to be appreciated. To facilitate the handling of steam heat a packless valve has been perfected which opens or closes quickly allowing the trainmen to give their attention to the passengers. There is also a twin type of this valve which is particularly intended for a vapor system, but can be utilized at any place where the controlling of two circuits is necessary. Circulars describing and illustrating these clever and handy appliances may be had on application to the company's office.

New Branch of the Joseph T. Ryerson & Son Company.

Joseph T. Ryerson & Son announce the establishment of warehouses in St. Louis for immediate service in their lines of finished steel to customers in the territory tributary to St. Louis. The house is fortunate in entering the field with the taking over of the plant, merchandise, equipment and good will of the W. G. Hagar Iron Co., and also in being able to immediately supplement this plant with complete modern warehouses and equipment for the handling and cutting of shapes, plates, reinforcing bars and similar heavy material.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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German Locomotives for the South Eastern & Chatham Railway

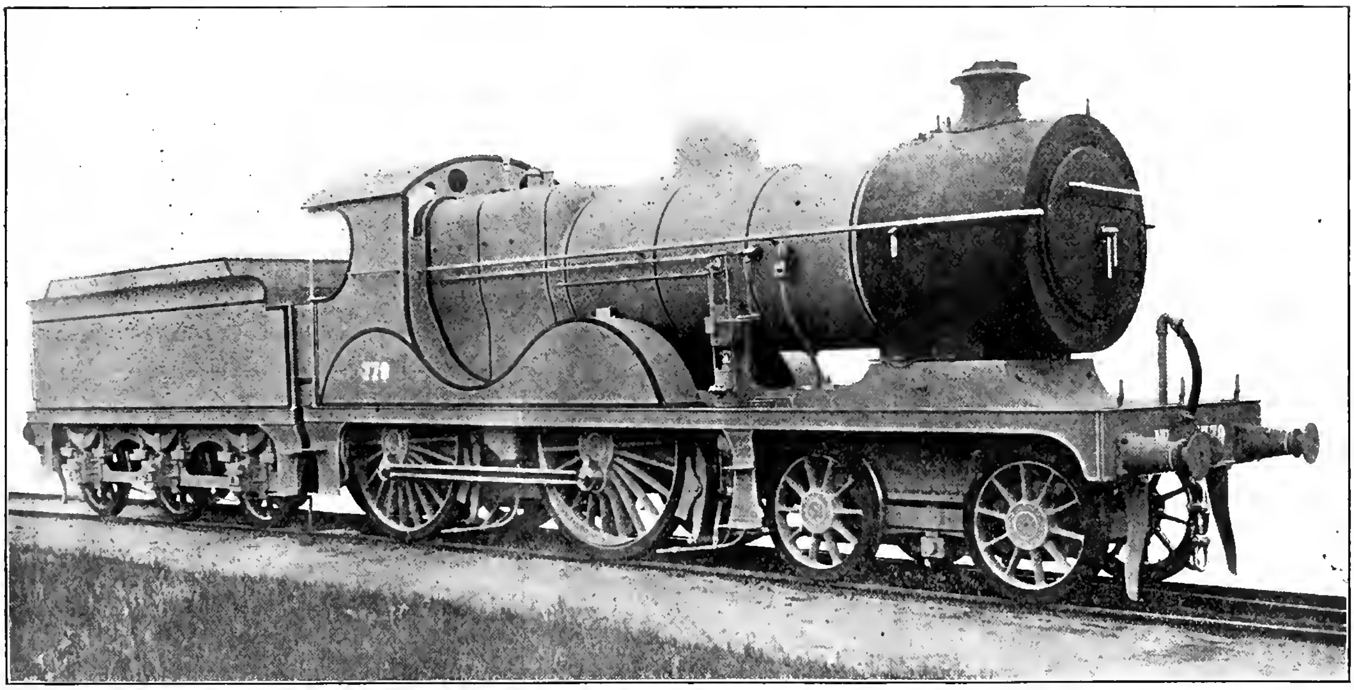
The European war-cloud that has burst with such unexpected and appalling fury, as it were out of a summer sky, has undoubtedly cut short the German locomotive industry as well as many other industries as far as the supply to the foreign market is concerned. It may not be generally known that locomotives made in Germany had recently begun to find favor on British railways. It is hardly to be imagined that the material or workmanship were in any respect superior to that of the British manufacturers, but the prices were lower, inclusive of the price of shipment from the German ports, and so the British railroad magnate pocketed his patriotic pride and bought in the cheapest market. Possibly the Kaiser thinks that after Europe is completely Germanized all the locomotives will be made in Germany. On the other hand, many enterprising British manufacturers are convinced that they have seen the last of the articles made in Germany and used in Great Britain. As neutrals we refrain from venturing any opinion on the matter, but in the meantime it may interest our readers to learn something of the most recent consignment of locomotives made by a German firm and now in regular service in Great Britain.

The accompanying illustration shows the type of ten express locomotives built by Messrs. A. Borsig, of Gegel, Berlin, for the South Eastern & Chatham Railway of England. The locomotives are equipped with superheater appliances, and although the engine and superheater apparatus are of German manufacture the complete boiler mountings as well as all other special equipment were supplied by British manufacturers to the specifications of Mr. R. E. L. Mansell, locomotive superintendent of the South Eastern & Chatham Railway. The locomotives are said to be fully meeting the expectations of the railway officials and are engaged in high-speed service with a degree of regularity that is not surpassed on any railway in Great Britain, and some of them are now working the main line express trains in connection with such of the European Continental service as is still running.

Some of the general dimensions of this type of locomotive are as follows:

Gauge, 4 ft. 8½ ins.

Cylinders, 20½ ins. diameter by 26 ins. stroke.



EIGHT-WHEEL EXPRESS TYPE OF LOCOMOTIVE FOR THE SOUTH EASTERN & CHATHAM RAILWAY OF ENGLAND.

R. E. L. Mansell, Locomotive Superintendent. Messrs. A. Borsig, Berlin, Builders.

Coupled wheels, 6 ft. 8 ins. diameter.

Bogie wheels, 3 ft. 7 ins. diameter.

Wheelbase of engine, 24 ft. 3 ins.

Wheelbase of tender, 13 ft.

Total wheelbase of engine and tender, 46 ft. 2¾ ins.

Boiler, 5 ft. diameter; length 11 ft. 5 ins. pressure, 160 lbs.

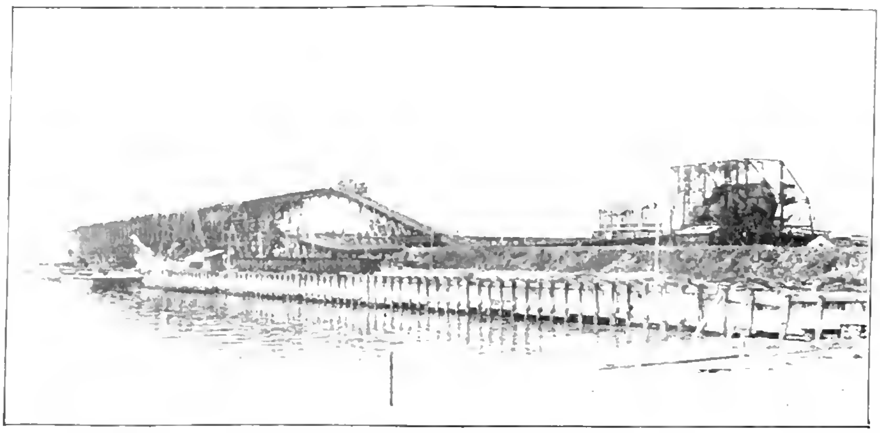
Tender, capacity 3,450 gallons of water and 4 tons of coal.

Total length over buffers, 56 ft. 3⅞ ins.

Height from rail to top of smokestack, 13 ft.

Rapid Development of the Virginian Railway
Largest Coaling Station in America

It may not be generally known that Hampton Roads is now the largest coaling station in America. The pier is 1,045 ft. long from bulkhead to outshore end, built entirely of steel on large concrete foundations, except the inshore end which consists of timber trestle approaches. It is about 78 ft. high above water level at outshore end and is 65 ft. on the top, accommodating three tracks—two delivery tracks and one central gravity return track. The capacity of the pier is over 15,000 tons per day of ten hours. The pier can accommodate eight ships, four on each side.



GENERAL VIEW OF SEWALL'S POINT COAL UNLOADING PIER FROM THE SHORE.

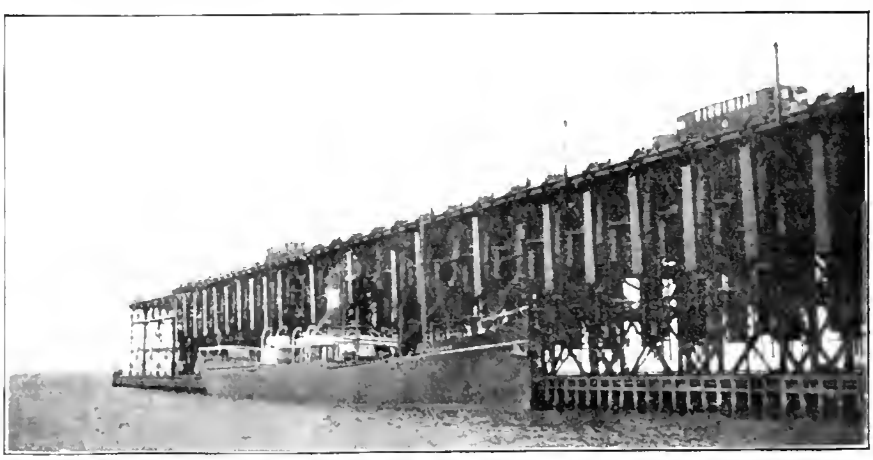
The machinery of the pier takes the coal from the receiving yard and pours it into vessels lying at the pier at the rate of a car every two minutes. It does this by means of a number of hopper-bottom, electrically-operated shuttle cars, each of which receives an entire railroad carload of coal at a time, carries it out on the pier, and unloads it through movable chutes into the vessel.

This immense pier is the tidewater terminal of the Virginian Railway. The basis of the value of the railway is coal—the service of the road is carrying coal from the West Virginia mines to the seaboard. The coal territory through which the road passes is extremely rich. The Virginian railroad operates from coal fields which contain over two million acres of the finest bituminous coal land in the United States. The road reunites the two sections of a great domain which was originally the single State of Virginia. Beginning in the southern part of West Virginia, after piercing the Allegheny Mountains, traverses Southern Virginia to the Atlantic Ocean. Its terminal, Sewall's Point, is a peninsula, jutting out into Hampton Roads, which forms the great harbor of the important commercial and maritime cities of Norfolk, Portsmouth and Newport News.

The construction of the Virginian Railway had the effect of releasing a great domain of natural resources, for it is unquestioned that the rich and extensive coal deposits of West Virginia are the most important body of wealth of the Old Dominion, next to that of Pennsylvania among twenty-nine coal producing States. No section in the United States east of the Mississippi river can show a greater endowment of natural resources than these wonderful States. There are only four counties in West Virginia where coal is not found in paying quantities.

The main line of the Virg'nian Railway is 442 miles long, connecting Deepwater, West Virginia, a gateway of Western and Southern internal commerce, situated on the New River near the head of navigation, with Sewall's Point in the Atlantic seaboard already referred to. It traverses the most active, productive and valuable coal mines in West Virginia and also the rich agricultural district of southern Virginia. The construction of the road throughout is of the most substantial kind, adapted for extraordinary coal-carrying work. The road is laid with 85-lb. rail, 2,880 ties to the mile—the majority of white oak—stone ballast, steel bridges of the heaviest American type and plate girder spans. The specified grades were: 0.2 per cent. compensated against eastbound traffic—80 loaded cars of 100,000 pounds capacity from the yards at the coal fields to tidewater, and 0.6 per cent. compensated against westbound traffic—returning empties in trains of equal length. The location and grade of the road was determined after making five and six thousand miles of field surveys.

There are about 128 steel structures of different lengths from 8 to 2,155 feet in length, the aggregate length of the steel structures being about 34,508 feet. Adequate telegraph and telephone train dispatching, signaling, interlocking and derailing, with coal and water appliances have all been provided for. The rapid growth of the business has called for extensive additions to the equipment. During the second year no less than 3,000 additional 50-ton steel coal cars were placed in service. The locomotive and car equipment in service is the best obtainable. The locomotives are mostly of the heaviest kind of the Mikado type. A number of Mallet type of locomotives have recently been placed in service, that are among the heaviest and most powerful locomotives in the world. With a tractive effort of 115,000 pounds and a



THE OUTSHORE END OF COAL PIER, SHOWING ADJUSTABLE CHUTES AND TWO CONVEYOR CARS.

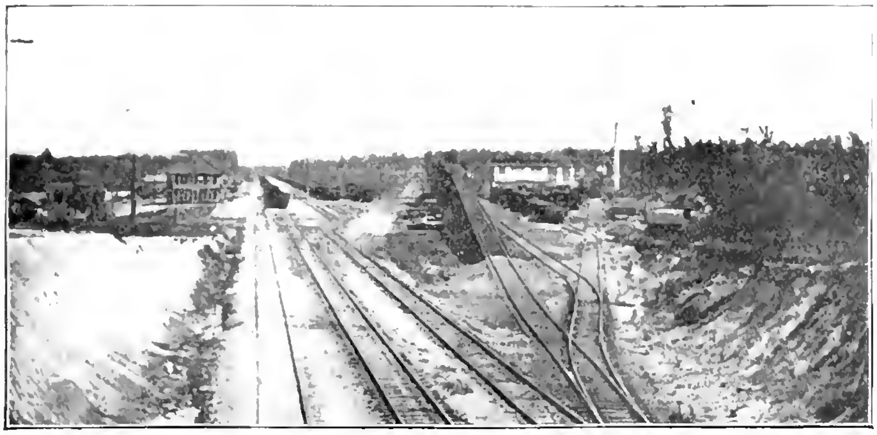
total weight of 744,000 pounds, these engines are in a class by themselves.

It may be stated that the crucial point in the railway is a portion between Elmore and Clark's Gap, on the Deepwater division, a distance of about 14 miles, nearly all of which is on a 2.07 per cent. grade with compensated curves of 12 degs. Two of these powerful

Mallets and one of the Mikado type haul over 4,500 tons over the steep grade referred to at a speed of over 15 miles per hour. The majority of the freight cars are of the flat bottom steel gondola type, adapted to the coal handling method at Sewall's Point pier, and also for general freight service.

The Glen Lyn Bridge over the New River is perhaps the most striking feature of this remarkable road. It stands today a justified model of engineering work. Further east there is another viaduct 1,650 feet in length.

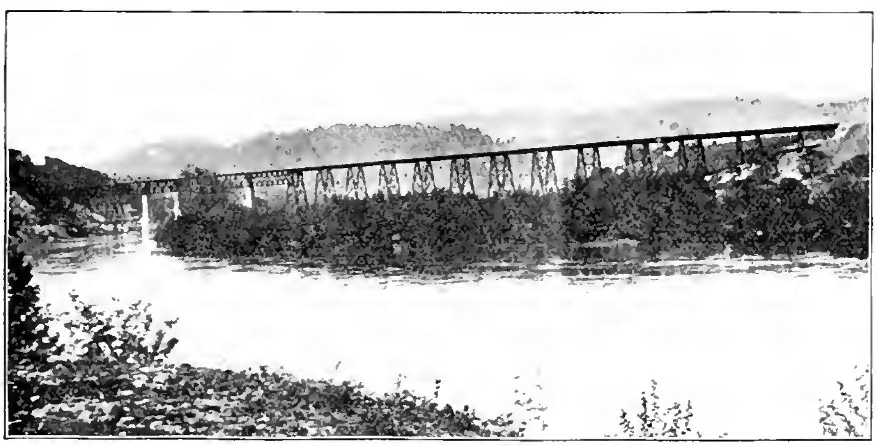
The traffic of the Virginian Railway is logically its own. Whatever competition there has been with existing roads is merely incidental and has not reduced the tonnage of these roads, but has rather increased them owing to the influx of population in the regions that have been opened up by the Virginian railway.



YARD AT VICTORIA, VA.—VIRGINIAN RAILWAY.

It may be added that the great and growing railway owes its existence to the mind and courage of Mr. Henry H. Rogers, the first president of the road, and who died in 1909 a few months before the road went on an operating basis. The enterprise which he so wisely conceived and so firmly established is being carried on with a high intelligence and a fixed resolution worthy of its first promoter. As a proof of the success of the enterprise during the second year the receipts from operation increased about 78 per cent., the net revenue from operation increased over 144 per cent., and gross revenue increased about 155 per cent.

In conclusion it may be conjectured as to what comes of all the coal now finding its way in increasing quantity to Sewall's Point. New England alone received last year 3,800,000 tons, supplied by vessels from the great port of Hampton Roads, and the increase in the future will doubtless keep pace with the growing requirements of the country.



GLEN LYN BRIDGE, NEW RIVER. THE LONGEST BRIDGE ON THE VIRGINIAN RAILWAY. LENGTH, 2,155 FEET.

The Swiss National Exhibition.

In spite of the appalling clash of arms in Europe it is gratifying to observe that considerable interest has been shown in the very comprehensive exhibition covering railway rolling stock, which is being held in Berne, the capital of the Swiss republic. The Swiss Federal Railroads are the largest exhibitors. Among other exhibits is the first locomotive (now about seventy years old) ever used in Switzerland, side by side with the newest and most modern locomotives employed for express trains on the St. Gothard line. The new Lötschberg Railway show their 2,500 horsepower electric engines, which, being the most powerful locomotives of the kind in the world, prove of utmost interest to technicians. The exhibits include also special invalid railway carriages, which can be used for international traffic, rotary snow ploughs, mail and luggage vans, also vans for the transport of wine, beer and meat, and other perishable articles or goods which must be kept cool.

The machinery hall has two galleries reached by electric elevators. The machinery exhibited includes steam and water turbines, pumps and mechanism used in the preparation of food products, also a Diesel oil engine. There are two main divisions in the hall, one for high-current and the other for low-current machinery. The exhibits of the Association of Swiss Electro Technicians and of the Swiss Electricity Works are under the same roof, Switzerland being one of the foremost countries in the application and knowledge of electricity.

Chilean Railway Extension.

The Northern Longitudinal Railway of Chile is now in full operation the work being entirely completed connecting Pisagua in the north of Chile with Valparaiso, Santiago, and Puerto Montt, well to the south of the country, a distance of about 1,960 miles. The new portion from Iquique to Calera, a distance of about 750 miles, has been constructed within the past three years and cost about $40,000,000, and is to be operated for 50 years by the Chilean Northern Railway Company, Calera, Chile, an operating company organized by the Howard syndicate, which supplied the money under a guaranty from the Chilean Government. The gauge of this line is 3.28 feet, while the gauge of the old portion of the Longitudinal Railway is 5 feet 6 inches.

Splendid Engine Performance.

Much intelligent energy has been devoted to training locomotive firemen to do their work so that the fuel that they supply to fireboxes shall perform its full duty in steam generation, but the results, as a rule, have not been worth boasting about. We have, however, seen figures of fuel used during a run on the Erie Railroad that show as good performance as any run we remember.

Engine 2,536, belonging to the Erie Railroad, made recently four trips over the first division, a distance of 512 miles with one tank of coal. The fire was cleaned four times on this supply of coal. The coal consumed was 51 pounds per mile. In one direction the train hauled consisted of seven cars, while on the return trip there were 11 cars. The engine crew are naturally proud of the performance, which is a very good sign.

General Correspondence

Early Locomotives.

EDITOR:

In the November, 1913, issue of RAILWAY AND LOCOMOTIVE ENGINEERING an article appeared in regard to the first ten-wheel locomotive, and credit was given to the Boston firm of Hinckley & Drury. In the December number following several readers took exception to the claim that Hinckley & Drury had built the first ten-wheeler, and stated that the Norris locomotive "Chesapeake" on the Philadelphia & Reading was the first of that type. As it was built in 1846, the claim is evidently well founded, because from the record of Hinckley & Drury it appears that their first ten-wheeler was not built until 1847, and on May 18 of that year they delivered to the Boston & Maine the engine "New Hampshire," with six coupled drivers and a four-wheeled truck. This engine was inside connected, with cylinders 16 inches by 20 inches and driving wheels 3 feet 10 inches and weighing 43,700 pounds. The tank had a capacity of 1,600 gallons and was mounted on two four-wheeled trucks.

On January 14, 1848, they delivered a locomotive of similar dimensions to the Northern Railroad of New Hampshire, and on June 29 and 30, 1848, two more of this type were built for the Michigan Central and bore the names of "Niagara" and "Aetna." These were followed on August 9 and 10 of the same year by two more, named "Hecla" and "Salamander," while the "Vesuvius" came next in September.

The Michigan Central was very progressive in its early motive power, and if any reader of RAILWAY AND LOCOMOTIVE ENGINEERING is fortunate enough to possess a photograph of any of these early ten-wheel engines the writer would be pleased to hear from him.

F. S. WYMAN.

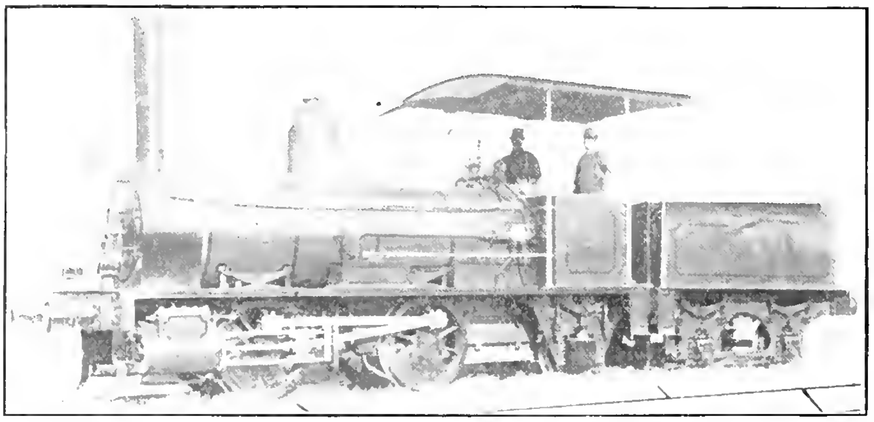
Waltham, Mass.

Old and New Australian Locomotives.

EDITOR:

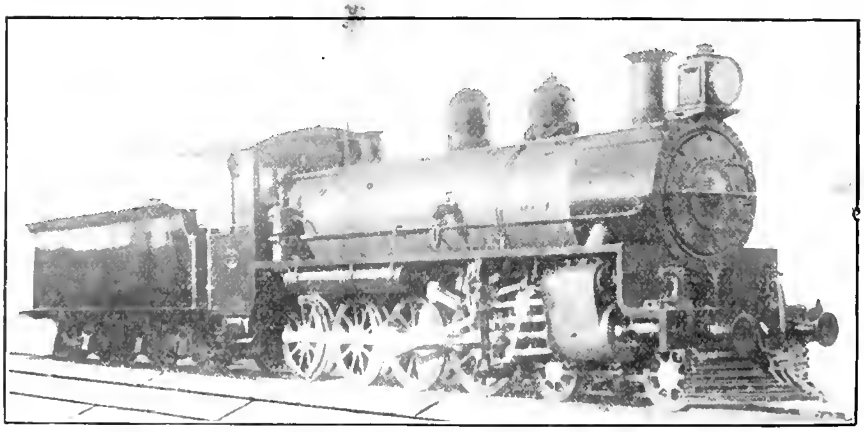
Enclosed are photographs of two of our locomotives, representing the oldest and newest types. Locomotive No. 3 used in 1864. It was built by Neilson & Co., Glasgow. Its cost landed in Queensland was £1,800. It is of the A10 class, four coupled wheels of 3 ft. diameter with radial pair 2 ft. diameter trailing. Cylinders, 10 ins. diameter by 18 ins. stroke. Boiler pressure, 120 lbs. Weight of engine in working order, 13 tons 13 cwt.; weight of tender carrying 2 tons 10 cwt. of coal and 560 gals. of water, 8 tons 9 cwt.; total weight of engine and tender, 22 tons 1 cwt. Tractive efficiency, 4,800 lbs., equal to hauling 53 tons over the Main Range at a speed of 15 miles per hour, or 110 tons on the level.

Locomotive No. 692 (1914 type), designed and constructed at the Government



FIFTY-YEAR-OLD LOCOMOTIVE STILL RUNNING IN QUEENSLAND.

Railway Workshops at Ipswich. It is of the C18 class. Eight coupled wheels of 4 ft. diameter; four wheeled leading bogie with wheels 2 ft. 4 ins. diameter; double bogie tender with wheels 2 ft. 9 in. diameter. Cylinders, 18 ins. diameter by 23 ins. stroke. Weight of engine in working order 51 tons; weight of tender carrying 7 tons of coal and 3,500 gals. of water, 40 tons; total weight of engine



LATEST TYPE OF LOCOMOTIVE CONSTRUCTED IN QUEENSLAND.

and tender, 91 tons. Tractive efficiency, 21,735 lbs., equal to hauling 240 tons over the Main Range at 20 miles per hour, or 500 tons on the level at 40 miles per hour. It is fitted with pneumatic ashpan (operated from cab) and first locomotive in Queensland to be fitted with piston valves and superheaters.

FRANK ANSCHAN.

Maryborough, Queensland.

Gasoline Driven Hand Cars.

EDITOR:

A trip across the American continent will reveal to any observing observer, ensconsed in the luxury of our tail-end cars, that the West is not so delinquent as is the East in furnishing modern devices for her section laborers. I was not a little surprised to see Western section men equipped with hand-cars devoid of pumping handles, same having been stripped of these labor absorbers because of the installation of gasoline motors within the bowels of the car.

In the East it is still the duty of man to expend his valuable muscular energy through the aforesaid handles and to find himself, each morning, tired, ambitionless at the part of his maintenance domain where the daily labor begins.

Such are the peculiarities of the East.

I am in favor neither of the East nor of the West. I am impartial. But to give the Eastern railroad man a tip, I might relate the methods employed by Western section foremen in furthering their own interests and the interests of their employ-

ing corporation or railroad company.

These foremen bought motors, suitable for hand-car propulsion, with money furnished from their own pockets. They had to dig down pretty deep, too, mind you; the cost of good power equipment totaling, in some cases, as much as $100. They did not act in unison, for it was not a plot against the railroad company. A laborer loves comfort and efficiency as well as you and I do. I know, for I once tamped ties and drove spikes, all of which is exhilarating and useful labor. Such labor is necessary, whereas pumping a hand-car via the hand-route is unnecessary as long as it can be done by power.

Other foremen on the same subdivision beheld this car, admired it, and coveted it, because they saw with half an eye that it was good. To prove their approval every foreman, to a man, bought an engine with his own hard-earned coin. The company, pleased with its progressive employees, gladly agreed to furnish the necessary gasoline. And after a time the company went even further. The company bought, outright, the entire equipment that had been previously purchased by the foremen.

The company now owns and furnishes gasoline hand-cars. The handle-cars are tabooed.

Mathematically, I cannot prove that gasoline cars are money-savers. They save time morning, noon, and evening because they travel at twice the speed attained by hand-pumping, and the money thus saved in a single year more than pays for the initial cost of the power equipment, with a crew of five men and a foreman. The surplus saving just about pays for the gasoline. The venture, therefore, comes out about even, figuring roughly.

Considering all points, though, I favor power drive for the same reason that I would prefer power drive on my wife's washing machine—if she did the washing. Where power drive is possible, and if it appears to be economic, use it. The chances are that, eventually, it will be economic.

N. G. Near.

Woolworth Building, New York, N. Y.

Fitting Locomotive Air Pump Piston Rings.

Editor:

The writer has noted with interest the query on page 257, July issue of Railway and Locomotive Engineering, relative to the above subject. After having tried the various methods of fitting these rings, I have adopted the springing method referred to. If a little care is exercised, just as good, and, under certain conditions, better results can be obtained by this method, and with a fraction of the cost of the spotting method, as it usually requires only about ten minutes to fit the four main cylinder rings.

Where it is desired to spot these rings, an excellent plan is to provide cast-iron templates, 3/4 in. thick and 15 ins. wide, bored to standard dimensions, viz., 9½ ins., 9 9-16 ins., etc., with an adjustable bracket to hold the template between the operator and the light, the relation between the periphery of the ring and template bore is easily observed, and with a little practice the ring can be filed down

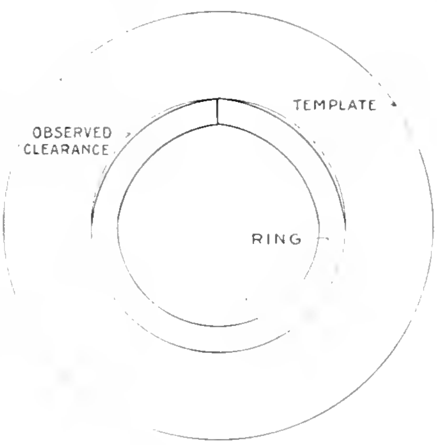


FIG. 1.

to conform to the template bore much quicker than spotting the ring to the cylinder. Illustration No. 1 shows an exaggerated view of the ring in a template. The use of these templates will also enable one to easily spring down a large ring to fit small bores.

After the ring has been filed down to

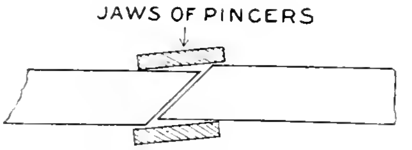


FIG. 2.

a correct bearing it becomes eccentric shaped. According to theory, in order to secure a constant unit stress in any section of the ring and a constant bearing pressure around the circumference, the ring would have zero thickness at the cut and maximum thickness opposite the cut; this, of course, would not be practicable, but

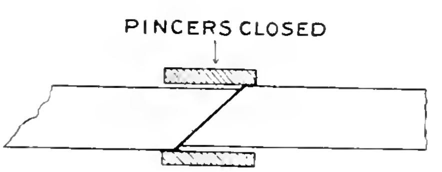


FIG. 3.

goes to show that perfection is practically not attainable in ordinary ring fitting.

The above described conditions are approximated in triple valve, or governor rings, etc.

The importance of having rings to fit properly in the groove of the piston cannot be overestimated, as these rings are really double-seated check valves, which prevent the escape of air which is usually under high pressure, and under these conditions any leakage by the piston rings means a marked loss of pump efficiency and a consequent danger of excessive heating.

Springing a ring to fit a cylinder bore overcomes the necessity of disturbing its periphery, or, in other words, the ring is sprung bodily out against the cylinder wall, its ends being used as a fulcrum to accomplish the same. (I might add just here that rings furnished by the Air Brake Manufacturers seem to be just right for springing.)

Just enough stock is removed from the ring ends to permit the ring to spring out against the cylinder wall all around when assembled in its respective piston groove. To determine when a sufficient amount of stock has been removed, force the ring side faces together with a pair of pincers or some other suitable tool, until the ring fits tightly against the cylinder wall (note illustrations Nos. 2 and 3), continue to file down the lap until the ring side faces are drawn almost parallel or until an overlap of about 0.002 in. remains. Considerable force will be required to move the piston and rings in its cylinder; this friction, however, has a tendency to smooth-up the cylinder quicker. (I might add here that any "bored" cylinder is more or less rough, and must be smoothed up by the action of the rings against it.) A 9½-in. pump ring has a rubbing surface of about 11 sq. ins. and the cylinder has a surface of about 300 sq. ins., hence the importance of smoothing up the cylinder with as little ring wear as possible.

After the pump has been assembled ready for test the air cylinders should be liberally lubricated with a light bodied oil, preferably through a sight feed.

J. A. Jesson,
Louisville & Nashville Ry.

Corbin, Ky.

British Cars and Corridors.

Editor:

In reference to British cars described in the August issue it is inferred that as the corridors are on one side, the vestibule is also on the side. This gives a wrong impression because the vestibule is central. A few cars with vestibules on the side were built many years ago, at the advent of the corridor. Of course, there are a great many non-corridor cars used on shorter runs, and naturally when corridor cars are mixed with these there is no inter-communication.

Another thing—it is stated that the cars are unadorned. It struck me that English cars are more elaborately decorated than American cars, but I think the severe simplicity of the latter is preferable. A plan, frequently adopted in England, is to have photographs of places served by that particular railway fixed

around the walls of each compartment. This serves as a simple decoration, is a good advertisement and frequently of interest to the traveler.

Although the English system of handling baggage is inferior to ours, it seems to me that its faults are exaggerated. I have traveled in England in a party of four or five people, and we never had any trouble in securing baggage promptly and never lost anything. Although there are many opportunities for baggage to be stolen, it must not be forgotten that there are chances for the same thing here, especially at smaller stations where trunks and other articles are left outside while the station agent may be at the freight house, situated a considerable distance away. WILLIAM G. LANDON.

New York, N. Y.

Setting Eccentrics and Broken Feed Valve Pipe.

EDITOR:

I have read in your August number the article on "Setting Slipped Eccentrics," by S. R. B., which I note he regards as a very simple and expeditious method, and with your permission I will now relate how Forney's Catechism taught the writer to set eccentrics on an indirect motion engine in 1878.

Place the crank on forward center on the disabled side, if the foregoing eccentric, place the reverse lever in full gear forward, put the large part of pulley above the axle, and move it forward until steam will escape from front cylinder cock, then fasten it.

If the back going one on the same side, place reverse lever in full back gear, put large part of pulley below the axle, then move it ahead until steam will escape from the same cylinder cock. In days gone by, many slipped eccentrics have been correctly set in this manner, and it is for your readers to judge which is the easier method.

The advice given in your August number by Messrs. Hahm & Burgh re broken pipes on No. 6 E. T. equipment does not, according to my understanding, cover the ground fully. I will intrude on your space by referring only to one part of their communication i. e., "Feed valve pipe broken off under automatic brake valve," and will offer the following as a mode of procedure.

Take all tension from regulating spring of feed valve and plug the opening under brake valve. Adjust maximum governor head for the desired brake pipe pressure. Disconnect distributing valve release pipe from automatic brake valve, carry brake valve midway between release and running position, which provides sufficient opening to supply brake pipe and does away with the necessity of making a blind joint on operating pipe of excess pressure governor head.

As this position of the brake valve allows main reservoir air to reach the spring chamber of this governor head, provided the pipe connection is made at the brake valve. If it happened to be an equipment with the top governor pipe connected to same part of the feed valve pipe (as they sometimes are) a blind joint would then be required in the operating pipe of this governor head, and the brake valve might be carried in full release position if desired.

Moncton, N. B. I. R. C.

Longest Stretch of Straight Railroad in the World.

EDITOR:

I see in a recent issue of RAILWAY AND LOCOMOTIVE ENGINEERING you state the longest stretch of straight railroad in the world without a curve is in New Zealand, the distance being 136 miles. This is incorrect as you will find by the enclosed maps of New South Wales and New Zealand. You will find the longest and most level stretch of railroad in the world is across the plain from Nyngan to Bourke on the Western Line of New South Wales Government Railways, the distance being, according to the official time-table, 126 miles. Height above sea level at Nyngan, 570 feet, and at Bourke, 350 feet; the highest point between the two towns being at Coolabah, 738 feet. The longest stretch of straight road in New Zealand is between Hornby and Rangitata, about 70 miles.

A. R. MERRIFIELD.

Sydney, N. S. W.

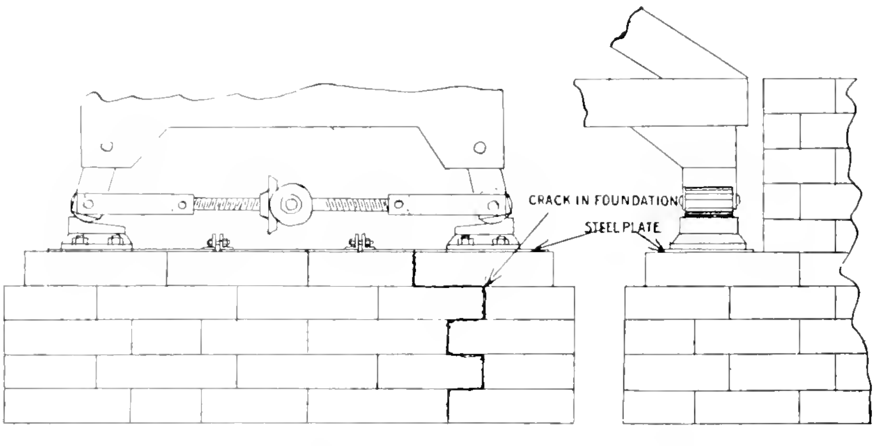
Clever Bridge Repair.

BY J. G. KOPPEL,

ELECTRICAL SUPERINTENDENT OF BRIDGES, SAULT STE. MARIE, ONTARIO, CANADA.

On the end piece of a swing bridge crossing the Ste. Marie Ship Canal at Soo, Ontario, a repair was recently made in a very efficient manner. The bridge is 407 feet in length, over which runs a single track for the Canadian Pacific railroad trains. The swinging and the end piece shoe-jacks operate by electric motors from a center cabin elevated over the track. From time to time it was found that the bridge tended to tilt to one side, especially the south end, which is on a curve, and finally a serious crack developed in the masonry which grew worse every day, and in order to keep the bridge safe we had to devise some kind of relief or safeguard to prevent a total rupture.

Arrangements had to be made to make the necessary repairs without interrupting the running of the trains on the track, and at the same time not to interfere with boats passing through the canal. The accompanying drawing shows the crack in the masonry which amounted to fifteen-sixteenths of an inch, and also shows how the repairs were accomplished. A one-half inch steel plate was made in three sections, and drilled to fit on the jack-shoe bolts, and one jack-shoe at a time was removed and the plate laid in place and the jack-shoe replaced. When both plates were secured in position, then the center plate was put in and the bolts screwed down, and when all were in tension the masonry was drawn into its original position, while a mixture of cement was poured into the crack, which made a very good job, as the foundation is now apparently as good as could be desired, and safer than the original structure, as nothing short of an earthquake could move the steel plate that we added to the structure.



BRIDGE REPAIR ON THE CANADIAN PACIFIC.

Not only so, but it is evident at a glance that a new idea has been added to structures of this particular kind. Masonry under direct vertical pressure is always reliable, but under slightly horizontal pressure of an intermittent kind, such as is caused by the oscillation of a heavy locomotive and attached train rounding a curve the tendency of the masonry to crack or dislocate is very great, and a reinforcing plate should be used.

Reminiscenses of Early Air Brakes.

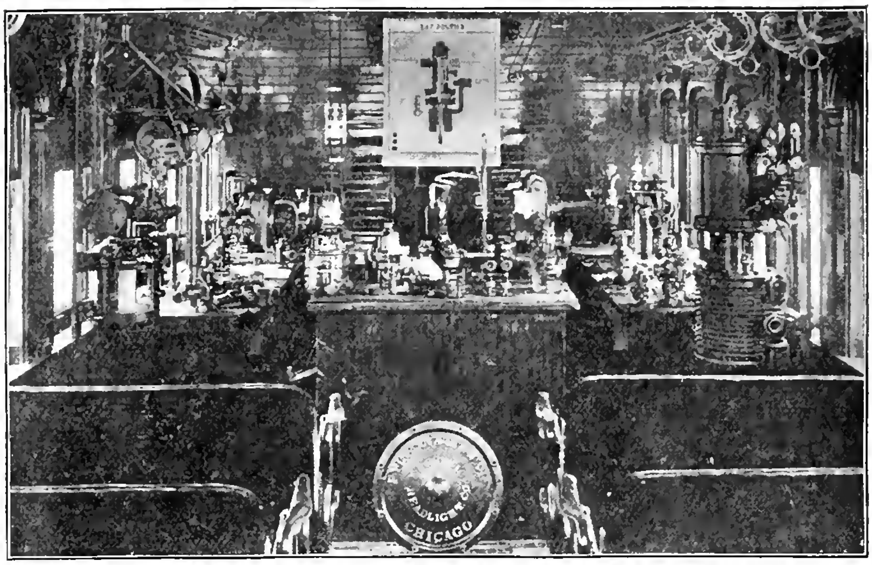
By Allan McDuff,
Cedar Rapids, Iowa.

As I now recall about the year 1874 when were were all studying the Westinghouse air brakes with the B. C. R. & N. Railroad, the disposition of the railroad managers in those days was to increase the speed of railway trains, especially on passenger trains. As the speed of trains was increased, the necessity for better devices to effect quick and powerful brakes was augmented, and thus steam or other power brakes had been substituted for human power. Continuous straight air brakes had been invented by George Westinghouse, all tending to increase the safety of passengers and prevent accidents. Abundant instances were cited wherein the safety or destruction of a fast train had depended upon whether two seconds or eighteen seconds had elapsed between the application of the brake and the development of the retarding force on the wheels of the cars in the train. It was claimed at this time that tests had been made, that theoretically a perfect continuous brake should stop a train running at 40 miles per hour in bad weather in a distance of 800 to 1,200 feet, in fair weather 260 to 320 feet.

The first Westinghouse air pumps we applied on locomotives of the B. C. R. & N. R. R., now a part of the Rock Island system, were the long stroke "6"-inch air pump, with main square piston rod and oscillating reversing piston valve. The brake was known as the straight air brake, as the automatic brake had not been invented at this time. Had the Westinghouse air brakes been as well understood by locomotive engineers and other men in charge of brakes as they are today, the Westinghouse straight air brake would have been more effective from its introduction, and would have developed more quickly during the first years of its trial. I, like a great many others in charge of the Westinghouse air brakes on cars and engines, and in charge of the repairs of same, searched for information on the principle of the air pump, but the only way to find this information was to study it out. At this time there was no air pump governor, instead there was a safety valve, and on the main reservoir there were no triple valves. Straight air brakes did not need triple valves. The engineer's valve was a three-way cock without any retaining valve in train pipe. The hose was rubber with straight coupling with valves in ends of coupling, the valves being held open in hose coupling by contact with one another. Those pioneer air pumps and brakes were exposed to the most severe service. When the engineer would apply the brake, he would turn on all the air in the main reservoir and leave the full communication open between main reservoir and train line. When he released the brakes he exhausted all the air on engine and train, then the pump would run off at a high rate of speed, pounding the lower air cylinder head and jarring the internal mechanism loose. Other bad things to be contended with in those days were the pump lubricant, steam cylinder, and air cylinder. The air pump had to be lubricated with tallow. We would get a lubricant of tallow from the butcher shops with pieces of meat in it. One of the defects in the air pump at the time I speak of would be what you might call candle in the valve chambers of the air cylinder of the air pump. The engineer, as a general thing in those days, had many ideas of how fast he wasted the air in making a stop, and when he did not have the pressure of air he would like to have, he would conclude that there was something wrong with the air end of the pump, and he would apply the tallow pot and fill the valve chambers of the air cylinder full of tallow; air strainers on the intake were not general in those days. When the tallow would become chilled and mixed with dust in valve chambers of air cylinder of air pump, then something would go wrong with the pump, there would be no air and have to brake by hand. I would take the cap of the upper air valve in air cylinder and find it solid with tallow and dust combined. Then I would remove upper air valves and seats, valve stop on lower air valve, take off lower air cylinder head, then take a hammer and a piece of a broom handle and drive a stick of tallow the full length of valve air chamber and diameter of valve seats, out of the air end of the pump, and take a wire and open the passage way across the cylinder head on upper end of air cylinder. Those were the principal devices of the pioneer Westinghouse air pump and continuous air brakes.

I had been constantly in charge of Westinghouse air brakes and other makes of air brakes on all the locomotives and cars of the B. C. R. & N. from 1874 to 1907, and my experience with the Westinghouse air brake has been that had the brake been handled in the same manner from 1874 until the automatic brake was universally applied, the results would have been different.

I have known engineers that have run their engines into the hind end of another train, or the front end of another engine, and reported their engineer's valve was out of order and would not operate the brakes, and felt outraged because they were suspended for thirty days. They said brakes could not be operated with an engineer's valve in the condition that the valve on their engine was in; they knew what they were talking about, and it was dead wrong to punish a man for something he was not to blame for.



INTERIOR OF INSTRUCTION CAR, NO. 653, WABASH ENGINEMEN'S SCHOOL OF INSTRUCTION.

I would have the engineer's valve removed from the engine, and coupled up to the train on the instruction car. I would call the traveling engineer and some other officer into the construction car, also the engineer that had got into trouble on account of his engineer's valve that would not work. He did not know that this was the valve that was taken off his engine. Would ask the engineer to take hold of that engineer's valve and show the traveling engineer and the other parties in the instruction car how he operated the engineer's valve on his engine when the train brakes would not take hold. He did make several reductions of air on train line, but the pistons on the brake cylinder would move out 2 or 3 inches and go back in the cylinder; the engineer could not see anything wrong, but the other men could. He did make reduction sufficient to apply the brakes, but kept on making a reduction on his

train that was not sufficient to set the brakes until all the air on his train was exhausted, then he stopped by coming in contact with the other train. This engineer was told that the engineer's valve that he was now handling was the engineer's valve that was on his engine when he got into the smash-up, and that there was not anything defective about the valve. The trouble was with the engineer and he was shown where he made the mistake. The traveling engineer took hold of the brake valve in instruction car that was blamed for the wreck and made emergency stops, and service stops in the presence of this engineer. Was convinced that the fault was with him, and also had convinced this engineer that if he had understood this engineer's valve and the principle of the brake he could use this valve as the old three-way cock and kept out of trouble.

MIXING APPARATUS.

When the automatic brakes were first applied on passenger trains they had to be applied as the engines and coaches were in the shops for general repairs. This meant that it required three or four years to change from straight air brakes to automatic air brakes, and during this time, on a three-car train, there would be at times two cars and the locomotive equipped with automatic brakes and one car with straight air brake. The straight air brake would be cut out, and the train would be controlled by the automatic brakes. At other times in a train of three or four cars and locomotive, the locomotive would be equipped with straight air brakes and also two of the cars. The automatic brakes in this case would be cut out and the train operated by the straight air brake. This was where we had the trouble. It appeared to be out of the question at this time to have engineers and trainmen study up in the principle of the air brakes, and they would forget how to handle, or the triple valve should be turned on a train of cars with mixed air brakes and the trouble would begin. The brakemen would have automatic and straight air brakes cut in on the same train. When the train pipe and auxiliary reservoir were charged for the running position of the automatic brake, the straight air brake would set, and when the straight air brake was released the automatic brake would set; then there would be something wrong with all the air brakes on the train, and the trainmen would conclude that there was no brake like the old Armstrong brake, and they would cut out the air and go braking by hand; but when the trainmen were compelled to get acquainted with the power brakes by taking instruction in the instruction car, then the air brakes began to show their advantage in stopping trains over the hand brake, and the trainmen became the friends of the power of the air brake. The instruction car was the educator of the engine and train men in operating the Westinghouse air brakes. The engineers and trainmen that were inclined to study would spend a good part of their time in the instruction car and become experts in the handling of air brakes.

The Western Railway Club, the Master Mechanics' Association and the Master Car Builders' Association adopted general rules and instructions for the care, repair and operation of the Westinghouse air brakes. The principal instructions, in my judgment, would be to keep all pipe joints and hose absolutely tight, all piston travel properly adjusted and all main and auxiliary reservoirs thoroughly cleaned out. In my experience of thirty years with the Westinghouse air brakes, there was more trouble and interruption in the operation of air brakes caused by dirty main and auxiliary reservoirs than from any other cause. When the engines and cars are undergoing general repairs the main and auxiliary reservoirs should be steamed out internally and properly cleaned of all oil and dust that have accumulated. The main and auxiliary reservoirs are the most neglected of any part of the air brake system.

When locomotives are in the shop for general repairs, the engine valves, the triple valves, the air pump, governor, the air signal valve used to go out as they came in; and when coaches are in the shops for repair, the brake cylinders triple and other valves are cleaned and repaired. Imagine a passenger train coming out of the shops with all brake cylinders, triple valves, engine valves, air pump governor and other valves all cleaned and repaired and then charged with air from a main reservoir that is in a filthy condition. On account of the oil and dirt that are allowed to remain in the main reservoir, any valve through which this air passes is polluted. As all the air on the train must first pass through the main reservoir, it is not sufficient to blow it out; the main and auxiliary reservoirs should be thoroughly cleaned out with steam.

I know from experience that the great part of the trouble with engine valves, triple valves and other valves is caused from a filthy main reservoir.

I have always been a friend of the Westinghouse air brake. The Westinghouse air brake has shortened the time, by half, between the Atlantic and Pacific oceans on the railroads. The travel on these trains is safer today than when the railroad trains made a speed of from fifteen to twenty miles per hour. The name of Westinghouse should be placed in history as one of the greatest benefactors to the general public in the last fifty years of this country's history.

Tube Making an Ancient Art.

It is wonderful how an art or system of manufacture may be lost sight of for centuries and after many days revive as something new and original. Iron and steel tube making is now one of the most important industries of the iron and steel trade. Yet less than a century ago iron pipes did not practically exist in Europe or any other part of the world. That is peculiarly strange because it is certain that wrought iron pipes were in use long before the revival of modern industries. There are wrought iron pipes to be seen connected with the baths of Pompeii and they were common in Rome and other ancient cities.

The modern manufacture of iron pipes began about 1820. About that time iron flange pipes were cast in 2½ ft. lengths and the joints packed with old bats. In 1811 and 1817 patents were secured for welding barrels of fire arms and in 1824 James Russell obtained a patent for constructing iron tubing, but about a year later Mr. Whitehouse obtained a patent on an improved system of iron tube making, which was the beginning of our great tube making industry.

Converting Wood Into Metal.

In many places of the world certain natural conditions have acted to turn wood into stone and in some cases this material is used for building and decorative purposes. We are not aware of wood being converted into metal or made to hold the property of metal by a natural process, but it can be done by artificial operations.

To convert wood to the resemblance of metal it is first placed in a bath of caustic alkali at a temperature about 190 degrees Fahr., where it remains two or three hours, the time depending upon the porosity of the wood. It is next treated to a bath of hydro-sulphate of calcium, where it remains for about twenty-four hours, when a concentrated solution of sulphur is added. After remaining in this mixture for twenty-eight hours the wood is removed to a bath of acetate of lead which is kept at a temperature of 100 degrees Fahr. Here it rests for fifty hours at a temperature of 170 degrees Fahr., when the process is completed.

When the wood subjected to this ordeal is dried, it is susceptible of a high polish giving the appearance of a metallic mirror. It remains unaffected by moisture, displays no signs of decay or corrosion and is remarkably durable, its only fault being that it is not so strong as the metal that it resembles.

It need hardly be added that the remains of trees that grew in primeval forests are frequently found in a petrified state as hard as the hardest rock, so that nature herself has means of changing soft wood into hard substances resembling the hardest minerals.

Elements of Physical Science

By JAMES KENNEDY

XXII. HYDROSTATICS.

Hydrostatics is the science that treats of liquids at rest, and differs from hydraulics that treats of liquids in motion and the machines in which the motion is applied. The incompressibility of liquids was long considered as a fixed fact, but modern experiments have proved the reverse to be the case. It has been discovered that the water at the bottom of the ocean, at a depth of five miles, is one-fortieth heavier, volume for volume, than the water at the surface. Water submitted to a pressure of 10,000 lbs. to the square inch loses one thirty-sixth of its bulk.

The general law of hydrostatics is that water at rest always finds its level. Advantage of this law is taken in supplying cities with water from elevated lakes or streams. The water may be conveyed through extensive depressions, but will rise again to the level from which it started. It is a remarkable fact that while the ancient Romans were familiar with the use of pipes in conveying water, they brought water to the cities through vast level aqueducts which were built at enormous expense. Possibly the difficulty in making strong iron pipes and keeping them tight at that time compelled the use of the great architectural works, some of which are still standing.

The spirit level, an instrument much used in all building operations, is an illustration of water finding its own level. If the air bubble in the instrument is in any other place than the center it shows that one end of the tube is higher than the other, and consequently that the surface on which it rests is not level.

XXIII. LIQUID PRESSURE.

The transmission of pressure in liquids differs from that on solids by reason of the fact that pressure on the latter continues only in the line in which it is exerted, while in the former it is transmitted in every direction. There is an increase in the lateral pressure of liquids according to the depth, hence the walls of dams and breakwaters should increase in strength toward their bases. This law leads to very remarkable results. Incredible effects may be produced by a small body of liquid having considerable depth. A strong cask may be burst with a few ounces of water in a long pipe inserted in the top of the cask. The cask being filled with water it will readily be rent asunder by simply pouring water into the tube. Many convulsions in the earth have been caused by this means, as a crevice in the earth's crust may be filled with rain water, and if the rent in the earth be sufficiently deep it may generate pressure so great that rocks may be rent in fragments.

Liquid pressure being thus in proportion to depth alone, a very small quantity of liquid will balanace any larger quantity. This remarkable quality is called the hydrostatic paradox. The best illustrations in mechanism are in heavy presses where a small jet of water is forced into a larger cylindrical vessel where the power may be multiplied a thousand times, the exact ratio being as the square of the diameters of the feed pipe and the square of the diameter of the press cylinder. Truck and engine wheels are pressed into place on the axles by this means. There is no limit to the power of the hydrostatic press other than the strength of the materials of which the press is composed.

XXIV. SPECIFIC GRAVITY.

The term specific gravity is used to express the weight of different substances. The standard employed is distilled water at 60 degrees. Distilled water is taken on account of its purity. The temperature is fixed because at a higher or lower degree of heat the density of the water would be affected. Fluids that do not mix when brought together, quickly arrange themselves in the order of their density, the heaviest finding their way to the bottom. The specific gravity of a body is its weight compared with that of a like bulk of water. The finding of the specific gravity of liquids is usually accomplished by the use of a glass vessel whose weight is known. Fill the vessel to a certain height and weigh it; substract the weight of the vessel, and note the weight of the water alone. Then fill the vessel to the same height with the liquid in question, weigh it again and subtract the weight of the vessel as before. Divide its weight by that of the water and the result will be the specific gravity of the liquid in question.

The specific gravity of solids is found by taking a certain bulk of the solid, ascertain its weight, and divide it by the weight of a like bulk of water. In the case of difficulty arising in obtaining a certain bulk of a solid body, other methods may be resorted to, the simplest being first to ascertain if the solid sinks in water, then weigh it first in air, and then in water by means of a balance prepared for the purpose. Divide its weight in air by the weight it loses in water, and the quotient will be its specific gravity. From these calculations it will readily be seen that if we know the specific gravity of a body we can easily find how much any given bulk of it weighs. A cubic foot of water weighs 1,000 ounces, or 62½ lbs., the weight of a cubic foot of any given substance will therefore be equal to 62½ multiplied by its specific gravity.

The following table gives the specific gravity of a few of the most important substances, the specific gravity of water being estimated at 1:

Platinum	22.069
Gold	19.358
Lead	11.445
Copper	8.788
Tin	7.291
Iron, cast	7.207
Anthracite coal	1.800
Soft coal	1.250
Ice	.930
Alcohol	.792

Oiling an Old Fashioned Throttle Valve.

Troublesome experience had instructed me to oil the throttle valve by turning the cylinders into force pumps, but the first time I saw this done, remarked an old master mechanic, imparted a lesson I have never forgotten. While still a rather green fireman, I was called one morning to go out on the 66. I reached the round house in good season and proceeded to oil round, a practice then in vogue. When this work was done I took hold of the throttle lever to run the engine out of the house and found it apparently immovable. Having seen accidents caused by greenhorns trying to handle engines with hard-working throttle valves, I decided to leave this one for the engineer.

When the engineer came, a stout, brawny man, to whom the engine was strange, he took hold of the throttle lever but did not start it. After meditating a little he finally succeeded in opening the valve sufficiently to admit steam to the cylinders and we proceeded to join the train.

The train was started all right, and when it was going at a good pace the engineer oiled the valves very liberally, then suddenly reversed the engine for a few turns and proceeded upon the journey. He then explained that reversing the engine converted the cylinders into force pumps, driving the oil back upon the throttle valve. I thought the proceeding to be very clever, but I afterwards found that the practice was quite common with locomotives having slide throttle valves.

Catechism of Railroad Operation

NEW SERIES.

Third Year's Examination.

(*Continued from page 288, August,* 1914.)

Q. 71.—Why is the eccentric on most Walschaerts geared engines placed more than a quarter of a turn back of the main pin when following the main pin, and less than a quarter of a turn ahead of the main pin when leading the main pin.

A.—To overcome the effect of the angularity of the eccentric rod.

Note.—On most modern engines the link is suspended so high that it is necessary to make the connection between the eccentric rod and link foot above the center line of motion. As a consequence of this condition in the construction of the engine the distance between the eccentric crank and point of connection with link foot when link was standing perpendicular (as it should be when main pins are on the dead centers) would be greater when eccentric was below the center line of motion than when the eccentric was above the center line of motion if the eccentric was placed at exactly right angle to the main pin. This is on account of the angularity of the eccentric rod, and would cause a distortion in the movement of the valve and an unequal distribution of the steam. To overcome this effect the eccentric is so placed that with main pins on either dead center, the distance between link foot connection, to eccentric rod, and eccentric will be equal, when link stands perpendicular and the eccentric is either above or below the center line of motion.

Q. 72.—How is the effect of the angularity of the main rod overcome with the Walschaerts valve motion?

A.—The combination lever establishes a connection between the piston and valve which will harmonize the travel of the valve with the travel of the piston, in this manner eliminating the effect of the angularity of the main rod.

Q. 73.—How is the link of the Walschaerts valve gear carried or suspended?

A.—It is hung on trunnion pins at its exact center as regards width and length, and the trunnion pins rest in boxes formed in the trunnion pin brackets so the link may rotate about the centers of the trunnion pins.

Q. 74.—How is the eccentric connected to the link on the Walschaerts valve gear?

A.—By the eccentric rod which connects the eccentric to an arm which extends down from the lower end of the link (called "The Link Foot") and as the eccentric rotates it gives the link the action of the upper and lower rocker arms in the Stephenson gear.

Q. 75.—What is the object of the "link foot" in the Walschaerts gear?

A.—To extend the lower end of the link down as near as possible to the center line of motion for connection with the eccentric rod.

Note.—The link foot is merely a convenience to perfect the point of connection with the eccentric rod and reduce the angularity of the eccentric rod as much as is practicable.

Q. 76.—To what is the link block in the Walschaerts gear connected?

A.—To the radius rod which establishes a connection with the valve through the combination lever and valve stem.

Q. 77.—Why is the "radius rod" so-called?

A.—Because the length of the radius rod, from center of point of connection with link block to center of point of connection with combination lever, is the exact length of the line used to describe the circle of which the link is an arc.

Q. 78.—What duties are performed by the combination lever?

A.—The combination lever gets the lap of the valve out of the way for admission of steam, gets the port open the desired amount of lead at the beginning of stroke of piston, and eliminates the effect of the angularity of the main rod by harmonizing the travel of the valve with the travel of the piston

Q. 79.—How is the Walschaerts geared engine reversed?

A.—By changing the manner of transmitting the motion from eccentric to the valve—changing it from direct motion to indirect motion or vice versa.

Note.—The manner of changing manner of transmitting motion is made possible through having the link suspended at its center and the link block moved above or below the point of suspension.

Q. 80.—Why is there a difference in manner of placing eccentric in relation to the main pin on different engines?

A.—Because there is a difference in the construction of the valve or on account of a difference in manner of transmitting the motion from the eccentric to the valve.

Q. 81.—What is the difference in manner of placing the eccentric where the valves are the same but the manner of transmitting motion is different, or where the valves are different and manner of transmitting motion is the same?

A.—Just one-half of a turn difference or 180 degrees.

Q. 82.—How far will the Walschaerts eccentric move the valve without any other influence brought to bear on movement of valve?

A.—When in full control it will move the valve built line and line (that would be a valve without any lap) just far enough to give the full port opening each way and no more, or we might, say that it will move the valve just the width of the port each way from the center of its seat.

Q. 83.—How far will the combination lever move the valve?

A.—Just twice the lap plus twice the lead of the valve during one complete stroke of the piston.

Note.—Without any eccentric connection, and with the link block placed in the center of the link so as to give a positive fulcrum for the combination lever on forward end of radius rod, the combination lever will move the valve far enough to have the port open the amount of lead when piston is at end of stroke.

Q. 84.—How is the proper location of the Walschaerts eccentric found?

A.—When the connection between eccentric rod and link foot is made above or below the center line of motion (at which time the angularity of the eccentric rod would affect the distribution of steam) the engine is placed with main pin on forward dead center so that center line of motion will cut the center of main pin and center of main axle, the link is placed exactly perpendicular and the eccentric is set at right angles to a line drawn from the center of the point of connection with link foot to the center of main axle.

Q. 85.—How much clearance is given the piston at each end of the cylinder and why is it necessary?

A.—The piston is given from one-fourth to one-half of an inch clearance, generally about three-eighths of an inch at each end of the cylinder to allow for the wear of the connections of the reciprocating parts and wear on shoes and wedges, to prevent knocking out cylinder heads.

Q. 86.—What results obtain when the combination lever on a Walschaerts gear is broken and the radius rod is connected to the valve stem as is possible on some classes of engines?

A.—The valve is moved far enough each way (with reverse lever in the extreme end of quadrant) to open the port the width of port less the lap of the

valve, and this opening will occur when the crank pins are passing the top and bottom quarters.

Q. 87.—What causes the cylinder to be ruptured or burst on engines equipped with Walschaerts valve gear and having piston valves?

A.—When the union link breaks it will allow the valve to move to the center of its seat and confine pressure in the cylinder which will be compressed by the piston until the walls of cylinder or the cylinder head gives out under the great pressure.

Q. 88.—What generally causes steam chests to burst?

A.—Compressed air, account of reversing the engine with cylinder cocks and throttle closed.

Note.—By reversing the engine you immediately change the engines cylinders into air compressors, and with the throttle closed this compressed air is confined in the steam chests and steam pipes until they burst. By opening the throttle the compressed air would pass into the boiler and the safety valves would relieve the excessive pressure.

Q. 89.—Where does this air get into the cylinders and steam chests?

A.—It comes down through the stack, nozzles and exhaust channels.

Q. 90.—If the exhaust gets out of square on the road what does it indicate?

A.—It indicates an improper distribution of steam, caused by some defect in valve motion or lack of lubrication causing friction to take up all the slack in worn parts of valve motion. Where the double exhaust tip is used, a bushing lost out of one tip will cause the exhaust to be out of square.

Washing Instead of Wiping Locomotives.

In the course of an exhaustive discussion of Engine House Economy at the Railway General Foremen's Convention, one member advocated the abandonment of wiping locomotives and said that the Delaware, Lackawanna & Western had adopted the practice of spraying the engines with hot water and kerosene, and that the results were very satisfactory. Mention was also made that the Atlantic Coast Line is trying this practice of cleaning the engines and the company's officials are well pleased with the experiment as far as it has gone.

We are aware that certain railroad companies have for years been in the habit of spraying with a water and oil emulsion the machinery parts of locomotives about to pass through the repair shops and it was found a better plan than that of wiping besides being much cheaper.

The practice of washing instead of wiping locomotives strikes us very favorably because the work of removing the dirt is likely to be much more thoroughly done than it is by the ordinary wiper. Wipers generally remove only the grease and dirt that comes most conveniently to their hands and defects of mechanism, such as cracks, are overlooked because the dirt covering them has not been removed. This is particularly the case with parts of the running gear that are seldom touched by the wipers' waste and are frequently heavily coated with grease and the contents of the road bed.

When an engine that has been thoroughly washed goes into the back shop for repairs, the workmen will be spared much disagreeable work in separating the parts that need work and rigid examination. Dipping the mechanism in vats charged with caustic ingredients has become a widespread practice, but a thorough washing is a more effective means of having the parts ready for repairing. We predict that the practice of washing instead of wiping locomotives is destined to universal adoption.

The Locomotive Engineer.

Some people have a curious idea of the duties and responsibilities of the locomotive engineer. A publication with pretensions to educate country people concerning popular science has this to say concerning the locomotive engineer:

"The engineer is the large, quiet man in overalls who acts as watchout of the modern locomotive. In the last thirty years locomotives have quadrupled in weight, but the same sized engineers are still used, and are giving very good satisfaction.

"The engineer is one of the few men who can ride free on our railroad trains nowadays. His is a pleasant life. All he has to do is to sit on a cushion seat and career blithely over and through the space and scenery and various obstructions.

"He does not have to work at all. The fireman does the work. All the engineer does is to pull the throttle and yank the reverse lever and manipulate the brake and watch the steam gauge and supervise the forced draft and jolly along the headlight dynamo and lubricate the steam dome and keep an eye on the superheater and block up one side occasionally, when the high pressure cylinder head blows out.

"The rest of the time he rides entirely at his ease and amuses himself by wondering if he can pick up the next switch signal soon enough to stop the train if it happens to be red.

"The engineer, it will thus be seen, leads a jolly life and enjoys a great deal of travel during the year. He usually travels about 250 miles a day, and when he gets off his engine he looks like Othello in overalls. If he travels too fast the company lays him off for speeding. If he travels too slow, the train dispatcher reports him, and if he suddenly stops traveling altogether in the middle of the journey, the coroner usually sits upon him and the officials try to prove that he wrecked his train and himself on purpose.

"The engineer is always present at all train wrecks, and usually he is in a reserved seat in the front row. When the engineer observes another 200-ton engine approaching his on the same track at the rate of 60 miles an hour he is supposed by etiquette to remain at his post. This he usually does, and when the wreckage is cleared away he is discovered holding the attacking engine in his lap.

"There are a great many different causes of wrecks in this country, but there is usually one standard result. The engineer is ruined for all future use as a citizen. It almost seems, sometimes, as if many railroad companies used no precaution against accidents beyond supplying engineers to serve as buffers between the opposing trains."

The Voice of the Locomotive.

There is something amusing about the different capabilities for making noise which different locomotives develop. When a locomotive is in first-class condition, properly proportioned and put together in a sound workmanlike manner; when all the working parts are in proper condition, every rubbing surface lubricated, every bolt, brace and nut tight, the only noises which ought to be heard in running are the beats of the exhaust steam and the vibrations of the wheels on the rails on striking the joints. Beyond these sounds every noise is a discord. But discords are no exception in the oratorio of locomotive engine running, for in many instances they are the rule instead of the exception.

A skillful thinking engineer can detect the cause of every noise made by the engine he is running, but some locomotives give forth such a tumult of violent sounds that no ear can identify the various notes. Some engines resemble men in their capacity for making noises. It is not always that they are in bad order that they rattle and pound, and tumble and jar everything near them. Engines of this kind get comparatively smooth and quiet as they work loose, while others are merely suffering from being too long debarred from their final goal, the scrap heap, and are uttering complaints of the usage they are receiving and pass through the peaceful country like a peripatetic boiler shop with riveters working full time. Even when off work engineers have a curious habit of listening to noises of distant locomotives and making comments that are always pertinent as to the condition of the locomotive, particularly of the adjustment of the valve gear.

General Foremen's Department

Locating Eccentric Keyways Before Setting the Valves.

By Linwood Skellinger,

Baltimore & Ohio Terminal, East Chicago, Ill.

In the course of my work as a locomotive machinist I have been called upon to "set valves" a great many times, and having done considerable studying on the subject I worked up a method of locating the eccentric keyways in the axle so that the valves would have the correct lead and save the work of changing keys just when the engine was about done and everybody hurrying to get finished. I have used this method of locating the keyways on six different engines and only found it necessary to change three keys, and these were on the first two engines.

The first point is to find the location of the center line of the link motion in regard to the crank pins. (See Fig. 1.)

In order to do this it is necessary to find whether the center line of the cylinders is above the horizontal center line of the driving wheels and if so, how much, and to find if the center of the link block is above or below the center line of the wheels and how much. By referring to Fig. 1 it will be seen that in the case I will use, for an example, the center line of the cylinders is up 4 ins. and the center of the link block is up 3 ins.

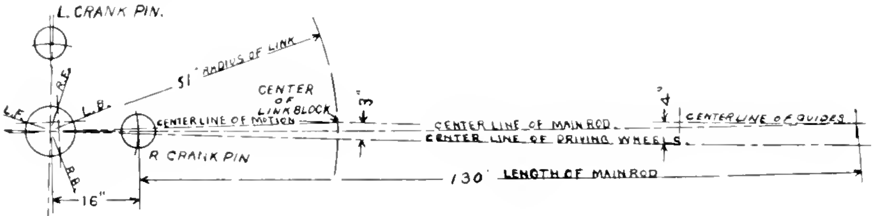


FIG. 1

By referring to Fig. 2 it will be seen how these three lines cross the radius of the eccentrics fit (the diameter of the axle where the eccentrics are located) which is 9 ins. in this case. Suppose we called the distance between the center line of the wheels and the center line of the main rod x, then as the length of the main rod plus one-half the stroke is to the radius of the axle, so the distance the center line of the cylinder is up is to x, or

$$\text{as } 130 + \frac{32}{2} \text{ is to } 4.5 \text{ ins. so } 4 \text{ ins. is to } x.$$

$$146 : 4.5 :: 4 : x, \text{ then } x = 12329 \text{ ins}$$

Now, let y = the distance between the center line of the wheels and the center line of the link motion. Then as the distance between the center of the axle and the link block is to the radius of the axle so the distance the center of the link block is up is to y, or

as 52 ins. is to 4.5 ins. so 3 ins. is to y

then $y = .25962$ in.

As it is the distance between the center line of the main rod and the center line of valve motion that we must know we will find the difference between x and y, which is .13613 ins. or 9/64 in., and as center line of motion is above the crank pin we must set the forward eccentric 9/64 in. closer to the crank pin than we do with the backward eccentric.

The next step is to find the angular advance of the eccentric which can also be done by a problem in ratio and proportion.

The stroke of the eccentric is 6 ins. The valve travel in full gear is 5½ ins., so the ratio between the two is as 5½ is to 6.

The valves have ⅞ in. steam lap, and in this case were to be set line and line, so we can state our problem as follows. As the valve travel is to the eccentric throw, so the lap of the valve is to the angular advance, or

as 5.5 ins. is to 6 ins. so .875 in. is to x. Then $x = .95455$ in., or 51/64 in. on 6 ins. diameter circle.

As we must work on the outside of the axle we will find the amount of movement on a 9-in. circle so

as 6 is to 9 so .95455 in. is to x

then x = 1.43183 or 1 7/16 ins.

Our next move is to lay out the axle and as it may or may not be pressed on the wheels I will give a method to cover both cases. In case the wheels are not pressed on we can place the axle on a face plate, plug up the center hole in the right end with lead, relocate the center in the lead and then lay out the lines shown in Fig. 2, as the center lines of motion main rod for right and left side. It is not necessary to put the center line of the wheels on the axle. Now, draw two lines, one parallel to each center line of motion and 1 7/16 in. distant,

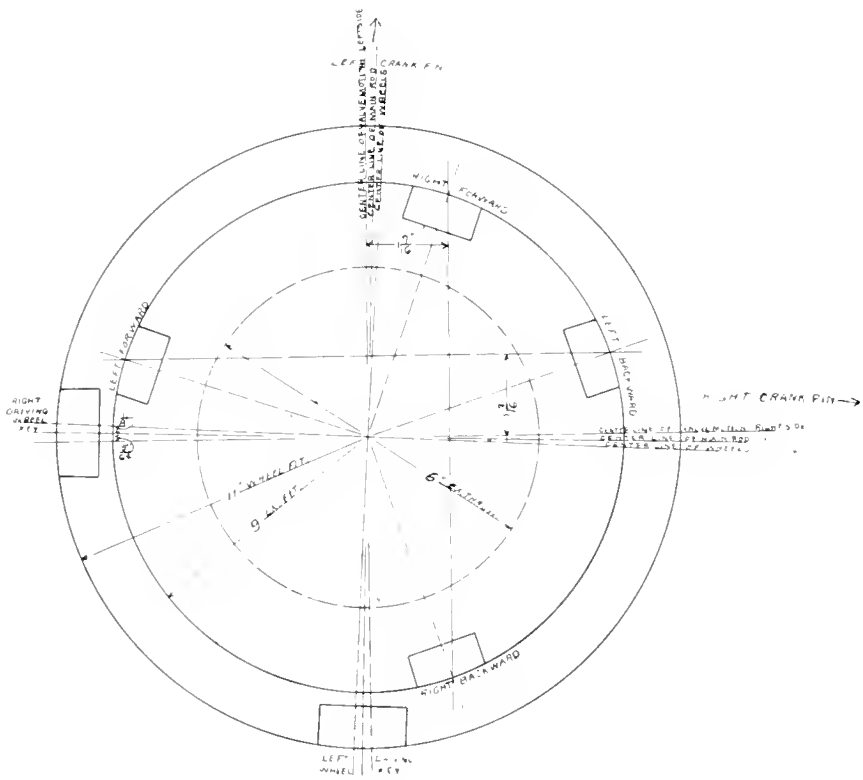


FIG. 2

toward the side where the crank pins will be.

Where these last two lines cross the 9-in. diameter circle is the center of an eccentric key and can be rolled until one of these intersections is the same height, as the center of the axle and the point showing the center of a key transferred to the proper position on the axle with a surface gauge. Repeat for the other three keys and the two driving wheel keys.

It is important that the driving wheel keyways be located correctly in regard to the eccentric keyways and that the wheels be pressed on so that the crank pins will not be out in regard to the eccentrics.

Suppose the wheels have been pressed on the axle and the crank pin pressed in the wheels, then we must proceed differently. If it is possible to locate the center of the crank pins on the inside of the wheel use a pair of tram points and transfer a line down to and across the axle for each pin. Now draw another line parallel to the first line 1 9/64 ins. distant, being very careful to move up on the axle when the crank pin is on forward center. Now, set a pair of dividers to cover the distance between the center line of motion and the center of one of the keys and it is easy to locate each keyway from these lines. It is better to take two steps with the dividers, however, as it is very hard to handle them on the curved surface of the axle.

In case it is impossible to accurately locate the center of the crank pins on the inside of the wheels a different method must be followed, in fact I use it altogether, as it gives as good results as can be obtained from the use of any of the others described in this paper.

Find the diameter of the crankpin just where it enters the wheel and scribe a circle with equal diameter, using the center of the axle as a center upon both ends of the axle.

Now, roll the wheels until the right crankpin is on the top quarter and drop a line over the crankpin with a pair of plumb bobs on the ends of the line. Roll the wheels until the lines are exactly in front of the circle on the axle. Now, take a combination square and place a center head on the scale with square head. Put the center head on the axle and push the scale down until it just touches the axle and move around until the level in the square head shows the bubble just level.

It is plain that the corner of the scale touching the axle is exactly in line with the crank pin. This is important.

I suppose some will say that it is easy to do this locating of eccentric keyways on new axles and on an engine where all the parts are correct to drawing and I agree with them, and I will give an account of how I placed the eccentrics on the axle of locomotive No. 5485 on the Chicago, Indiana & Southern Ry. at Gibson, Ind., in August, 1913, after I had laid the axle out for locomotive No. 5491.

The keyways were already drilled and chipped and the eccentrics had keyways cut in them and no eccentric had the keyway located correctly. In checking up on engine 5485 I found that the engine was 1 in. higher on the spring rigging than standard, so that was necessary to figure out the center line of motion again as the center line of the cylinder was up 5 ins. instead of 4 ins. and the center of the link block was up 4 ins. instead of 3 ins., so we have

$$146 : 4.5 :: 5 : x. \quad x = .15411 \text{ in.}$$

$$52 : 4.5 :: 4 : y. \quad y = .34615.$$

The difference = .192 = 12/64 or 3/16 in.

In checking up the port lines on engine 5485 I found that the right side had ⅞ in. lap and the left side had 29/32 in. lap. Upon trying the motion work with a bar I found ⅛ in. lost motion on the right side and ¼ in. lost motion on the left side. Upon referring this to the foreman I was told that inasmuch as the engine only needed a new main axle to replace the broken one to put it in service that no work was to be done on the motion work at all and that they wanted the engine to be line and line regardless of the lost motion in the links and other attachments.

On account of the difference between the two sides in regard to steam lap of the valves and the amount of lost motion it was necessary to figure the angular advance of the eccentrics for both sides. We will take the right side first:

Let x = angular advance, then

$$5.5 \text{ ins.} : 6 \text{ ins.} :: .875 \text{ in.} : x.$$

$$x = .95455 \text{ in. or } 61/64 \text{ in.}$$

To 61/64 in. it is necessary to add one-half of the lost motion, making it 61/64 + 1/16 = 65/64 in., or 1.01705 in.

$$6 : 9 :: 1.01705 : x$$

$$\text{then } x = 1.52559 = 1\ 17/32 \text{ in.}$$

Now take the left side: 29/32 in. lap = .90625 in.

$$5.5 : 6 :: .90625 : x$$

$$\text{then } x = .98636.$$

To .98636 we must add one-half of the lost motion, which is ¼ in., or .25 in.

$$.98636 + .25/2 = 1.11136 \text{ in.}$$

$$6 : 9 :: 1.11136 : x$$

$$\text{then } x = 1.66674 \text{ in., or } 1\ 43/64 \text{ in.}$$

Fig. 3 will show a diagram of the keyways in the axle the same as in Fig. 2, but with the new centers for the eccentrics as they should be placed on locomotive No. 5485. The keyways in the axle

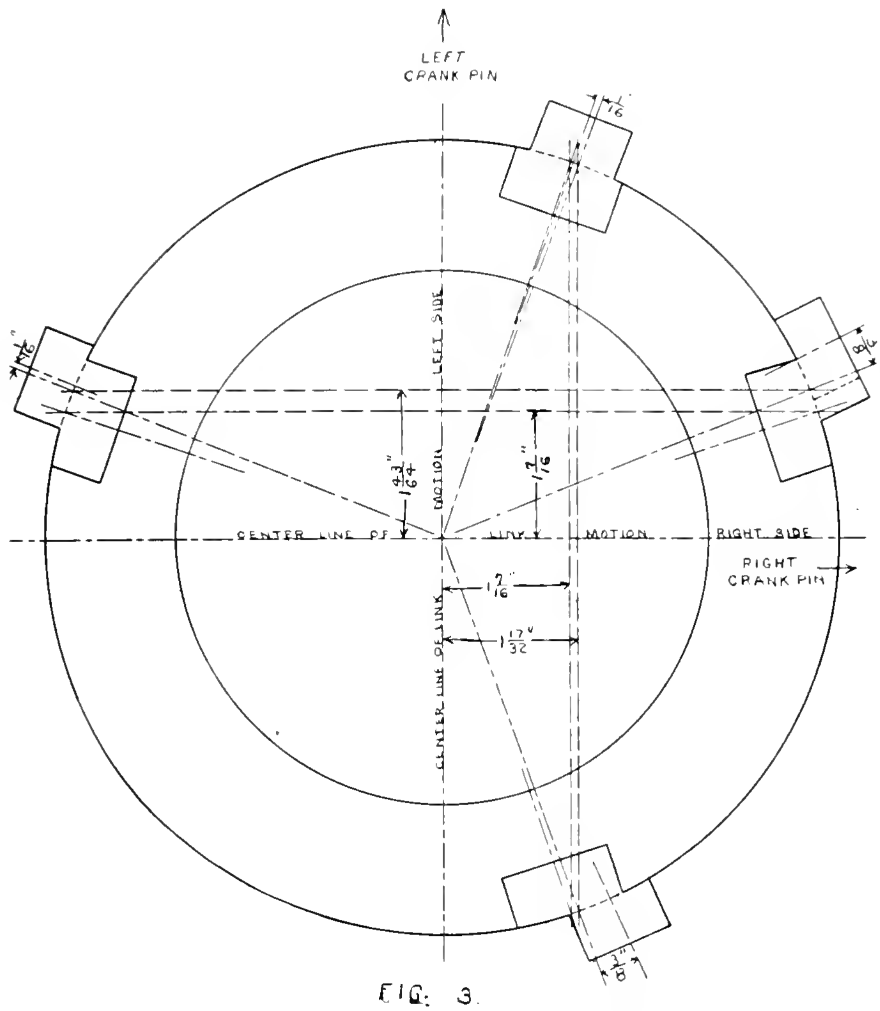


FIG. 3.

were already drilled and chipped 1¼ in. wide by ⅝ in. deep, but the keyways in the eccentrics on engine 5485 were only 1 in. wide by 9/16 in. deep and no eccentric keyway was laid out correctly central to the center line of the eccentric, which is also shown in Fig. 3.

The offset for the left backward key was so much that it only left one-half of the key, so I sent the eccentric to the machine shop and had ¼ in. planed out on one side of the keyway, and added an equal amount to the key so the key would be strong enough. I had all the keys planed as shown in Fig. 3 and keyed the eccentrics on the axle, and as they were supposed to be correct I did not put the valve rollers under the wheels at all, but caught the centers both ways by pinching the engine to find the changes to be made on the eccentric blades and to prove the laying out of the keyways.

The following list gives the result:

Right forward eccentric....1/64 in. lead.
Right backward eccentric... 000 in. lead.
Left forward eccentric.....1/32 in. lead.
Left backward eccentric....1/64 in. lead.

This is very close considering the amount of lost motion in the valve gear, so the blades were changed to square the valves and the engine returned to service in considerable less time than it would have been had it been necessary to remove all eccentrics from the axle, put in new keys and replace them.

Coloring Metals.

Metals may be colored quickly and cheaply by forming on their surface a coating of a thin film of a sulphide. In five minutes brass articles may be coated any color, varying from gold to copper-red, then to carmine, dark red, and from light aniline blue to a blue-white, like sulphide of lead, and at last a reddish-white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The colors possess a very good luster, and if the articles to be colored have been previously thoroughly cleaned by means of acids and alkalies, they adhere so firmly that they may be operated upon by the polishing steel. To prepare the solution dissolve 1½ oz. hyposulphite of soda in 1 lb. of water and add ½ oz. of acetate of lead dissolved in ½ lb. of water. When this clear solution is heated to from 190 degs. to 200 degs. Fahrenheit it decomposes slowly and precipitates sulphide of lead in brown flakes. If metal be now present, a part of the sulphide of lead is deposited thereon, and according to the thickness of the deposited sulphide of lead the above colors are produced. To produce an even coloring, the articles must be evenly heated. Iron heated with this solution takes a steel-blue color and will retain the coloring unless some abrasive is used to remove it.

Filing Metal.

To file a surface true, it is necessary on commencing to squeeze the file tightly between the third and fourth fingers and palm of your hand until you become used to it. Your position in filing should be half face to your work, with the middle of your right foot fifteen inches behind your left heel; and to file your work true or square, it is necessary to reverse your work often, as by this means you are enabled to see the whole surface you are filing and see while filing whether you are filing true or not. When, however, your work is so heavy that you cannot reverse it, you had better file first to the right and then to the left, as by this means you can plainly see the file works, and this again helps you in filing true.

Early Authority on Locomotives.

In 1835, when railways were yet in their infancy, Chevalier De Pambour, a French engineer, wrote a book called "A Practical Treatise on Locomotive Engines," which was for years the best authority on the construction and operation of the locomotive. The work was to a great extent based on experiments carried out on the Liverpool & Manchester Railway. Much attention was devoted to friction and the resistance of trains. In that respect Pambour was the most reliable authority until D. Kinnear Clark experimented in the same line twenty years later.

Market for American Railroad Equipment.

The railroads of Portugal are greatly in need of new equipment, and there should be a market for American locomotives. The only service which is satisfactory to the traveling public includes two trains a day to Oporto, a wagon-lit (sleeping car) service daily to Paris, and another three times a week to Madrid. The tracks are all broadgauge, as in Spain. With the exception of the accommodations on the trains mentioned the equipment is poor.

List of Committees and Subjects for 1915.

The following are the list of topics and subsidiary papers which will be presented for discussion at the next annual convention of the International Railway General Foremen's Association, and the names of the chairman and members of the various committees having the subjects under consideration. It will be noted that the subjects are of importance and much valuable information of a first-hand kind may be expected, in view of the experience and ability of the members forming the committees:

Topic No. 1.

VALVES AND VALVE GEARING.

W. Smith, chairman, C. & N. W. Ry., Chicago, Ill.

Committee.—Charles A. Barnes, C. & W. I. Ry., Chicago, Ill.; J. Miller, I. C. Ry., Chicago, Ill.; G. W. Keller, N. & W. Ry., Portsmouth, O.; N. J. Shasberger, L. S. & M. S., Collingwood, O.; T. M. Dewar, C. & O., Covington, Ky.; C. D. Rafferty, K. & M., Middleport, O.; F. Anderson, C., St. P., M. & O., Sioux City, Ia.; B. F. Harris, S. P. Ry., Oakland, Cal., and H. J. Sentman, Big. 4, Bradford, O.

Topic No. 2.

RODS, TIRES, WHEELS, AXLES AND CRANK PINS.

A. A. Masters, chairman, D. & H. Ry., Watervliet, N. Y.

Committee.—H. E. Warner, L. S. & M. S., Elkhart, Ind.; A. F. Taylor, Soo Line, N. Fond-du-Lac, Wis.; W. T. Gale, C. & N. W., Chicago, Ill.; W. G. Reyer, N. C. St. L., Nashville, Tenn.; A. B. Clark, C. G. W. R., Olewein, Ia.; A. B. Corbett, M. K. & T., Dennison, Tex.; W. F. Lauer, I. C., Memphis, Tenn.; F. O. Miller, C. M. & St. P., Dubuque, Ia., and M. J. Hayes, T. H. & B., Hamilton, Ont.

Topic No. 3.

SHOP EFFICIENCY.

George H. Logan, chairman, C. N. W. Ry., Clinton, Ia.

Committee.—M. H. Westbrook, G. T. Ry., Battle Creek, Mich.; E. E. Griest, Penna. Lines, Ft. Wayne, Ind.; J. M. Kerwin, R. I. Ry., Silvis, Ill.; J. Miller, I. C. Ry., Burnside, Ill.; F. A. Byers, St. L. & S. F., Springfield, Mo.; I. C. Newmarch, L. S. & M. S., Cleveland, O.; Wm. Smith, P. & L. E., McKeesport, Pa., and C. M. Newman, A. C. L., Rocky Mountain, N. C.

Subsidiary Paper No. 2.

OXY-ACETYLINE WELDING.

F. A. Byers, chairman, 'Frisco Line, Springfield, Mo.

Committee.—J. M. Kerwin, C. R. I. & P., Silvis, Ill.; L. A. Hardin, C. & N. W. Ry., Boone, Ia.; C. L. Dickert, C. of Ga., Macon, Ga.; I. C. Newmarch, L. S. & M. S., Cleveland, O., and J. F. Bergenheimer, L. & N. Ry., New Albany, Ind.

Subsidiary Paper No. 1.

ROUND HOUSE EFFICIENCY.

N. B. Whitsel, C. & W. I. Ry., chairman.

Committee.—A. W. Ensign, C. G. W. Ry., Clarion, Ia.; W. S. Whitford, C. & N. W. Ry., Milwaukee, Wis.; Chas. Snyder, A. T. & St. F., Chicago, Ill.; S. J. Harper, Y. M. V. Ry., Vicksburg, Miss., and W. B. Middleton, A. C. L., S. Rocky Mountain, N. C.

Questions Answered

TESTING FOR LEAK.

C. E. A., Harrisburg Pa., asks: How would you test defective cylinder packing, defective valves or valve rings, and how can it be ascertained on which side the leak occurs? A.—Cylinder packing may be readily tested by having the engine moved until the piston is some inches from the end of the stroke. Admit steam to the piston and open the cylinder cocks. An escape of steam from both cocks indicates a leak in the piston rings. The valves may be tested by placing the valve in the center and by opening the cylinder cocks, or observing the exhaust pipe it will readily be noted if steam is escaping. The trained ear readily detects the variation between a leak on the valves as distinguished from a leak in the pistons. A leaky valve produces a screaming sound, a leak in the piston rings has a deeper or groaning sound. The open cylinder cocks or exhaust pipe will readily indicate on which side the leak occurs.

TRACK GAUGE.

E. B. S., Hartford, Conn., writes: In your July issue on page 259 you describe the new locomotives purchased by the Pennsylvania railroad company. In the notice of the general dimensions the gauge is given as being 4 feet 9 inches. Why is this given instead of 4 feet 8½ inches, as it has always been given before? A.—The gauge of the Pennsylvania railroad admits 4 ft. 9 ins., and the dimensions of the locomotives referred to were in accordance with the specifications submitted by the company's engineers.

DEFECTIVE EXHAUST WHEN PRIMING.

A. C. R., Burghersdorp, South Africa, writes: We still have a number of American locomotives employed on some of our lines equipped with the balanced slide valves, indirect motion. In working these engines we find that when priming takes place that the engine will lose one of the exhaust beats, that is instead of having four beats there will be only three beats. This only occurs when the boiler is priming. As may be expected this subject has caused a considerable amount of controversy among the enginemen here, and much variety of opinion exists as to the cause. We would be pleased to have your opinion as to what causes this apparent peculiarity, and thereby help us to quell the controversy. A.—This is not due to the action of the valves, but may be owing to the fact that so much water collects in the cylinders that it chokes or muffles the exhaust, and some of the beats are apparently lost. When priming occurs, the cylinder cocks should be kept open. Some enginemen are apt to overlook this necessity The fact that the valves are of the balanced type is a decided advantage as compared with unbalanced slide valves. It has also been noted that an excessive amount of water in the boiler affects the action of the valves when the valves and valve seats are much worn as the water finds its way between the valve and seat, choking the exhaust. It is also to be expected that water striking in the cavity of the valve has the effect of momentarily lifting the valve from its seat and so induce a choking of the exhaust, but a continuance of three clearly uninterrupted beats and a complete pause where the fourth beat should occur is a very singular occurence. If this is really so, and the regularity unvarying, two things are apparent, first that the hiatus occurs on one side only, and secondly that there must be some peculiarity in the valve motion on that particular side that should be the subject of special investigation.

AUTOMATIC SANDERS.

E. S. Hamilton, N. S. W., writes: Could you tell me if there is any brake in use on American railways or electric lines that operates a sand valve in conjunction with the brake application? A.—In railroad service the track sanding devices, while operated with compressed air, are generally separated from the brake apparatus; however, the Westinghouse Air Brake Company is prepared to furnish brake valve attachments whereby a movement of the handle either to service or emergency position automatically opens the sanding valve, or rather the arrangement is such that a downward pressure on the brake valve handle opens the sanders, therefore sand can be started at any time with the brake valve, or need not be used if considered undesirable.

"ROUGH STOPS."

J. B., Montgomery, Ala., asks: Will you tell me in your question and answer columns, why is it that rougher stops are made with passenger trains when the engine has the "E. T." brake than when the older "G-6" brake valve is used?

A.—It is due to some incorrect handling of the brake valve, as the "H-6" brake valve has the identical features of the "G-6" valve and some others that can be used or dispensed with at the will of the engineer; hence, if the smooth stop can be made with the "G-6" valve, the same thing can be done with the "H-6." If you will state some specific case giving the make-up of a train type of brake equipments on cars and method of manipulation, we may be able to point out just where the mistake is being made and how the rough stop may be avoided.

POWER TRANSMISSION.

R. S. M., of Dallas, Texas, writes: Why is it not desirable to use iron wire instead of copper wire for power transmission? A.—There may be special cases where it is desirable to use iron wire, but it is not economical unless the size of copper wire which would give satisfactory operation is too small for mechanical. For instance, if a No. 20 copper wire, which is .032 in. in diameter, was correct for electrical reasons, still it is not suitable for mechanical reasons due to its small size, and iron wire could be used to advantage.

The resistance of iron wire to alternating current is higher than for direct current by 2 to 3 times and this fact should be borne in mind when calculating the proper size of iron wire. The resistance to alternating current compared to the same size of copper wire is 20 to 1.

Leaflet 3723, issued by the Westinghouse Electric & Manufacturing Company describing Baldwin-Westinghouse industrial locomotives, shows a number of installation views of this class of apparatus, and a description of the characteristics of the locomotives is also given.

"SUBSTITUTE VALVE CHAMBER CAP."

J. B., Montgomery, Ala., writes: Can the cap nut of an 1¼-in. angle cock be used in place of the reversing valve chamber cap of the 9½ pump in case the air pump cap nut is lost?

A.—The threaded portions are of the same size, and if the pump is in good condition otherwise it will run, but have a heavy blow at the exhaust on the up stroke of the piston.

Recovery of Waste Coal.

The old culm banks in the Pennsylvania anthracite coal region are rapidly disappearing. Since the first washery was constructed in 1890 the total recovery of this waste product has been 50,000,000 long tons of usable fuel. The average value increased in 1913 to $2.39 per ton. The waste from the washeries serves a useful purpose; flushed into the mines it partly fills old workings, where it cements together and supports the roof, thus preserving farm lands.

Removal of Chicago Car Heating Company's Southern Office.

The Southern office of the Chicago Car Heating Company has removed from 521 Realty Trust building, Atlanta, Ga., to 829 Munsey building, Washington, D. C. The office will be in charge of Mr. Harry F. Lowman, Southern manager, whose qualities have endeared him to the Southern patrons of the company.

Wm. Wharton, Jr. & Co., Inc., Philadelphia, Pa., have appointed R. T. Hoffman & Co., Inc., their representatives for the southern Atlantic coast states, effective August 1. The latter company has main offices in the Continental Bank building, Baltimore, Md., and an Atlanta, Ga., office in charge of H. F. McDermott in the Candler building.

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The Railway Freight Decision.

After many months of waiting the Interstate Commerce Commission has at last given out its decision on the application of the railroads of the Eastern District for an increase of five per cent. in freight rates. The commission has refused to do anything for railroads in the territory east of Pittsburgh and Buffalo, but between these points and the Mississippi River it authorized increases in commodity rates that will probably add $15,000,000 a year to the gross receipts of the roads benefited. This decision comes at a time when it has become a matter of minor importance not only on account of the war in Europe, but of other important changes and conditions which took place last month.

The commission has not added to its popularity by its decision.

In the first place the Interstate Commerce Commission has become so bureaucratic in its methods of doing business and its dilatory practices and hair-splitting rulings that any shipper or railroad having a case before it finds that its procedure is no improvement on that of the ordinary courts, regarding which every one is agreed, and which may some day be reformed along the lines laid down by ex-President Taft in repeated utterances upon the subject. The commission's ruling in this case includes a lot of advice to the railroads, some of which surprises the people of this country. The commission recommends the railroads to increase their passenger rates and make good their deficits or increased expenditures for labor out of the pockets of the traveling public. The burden is to be heaviest on the pocketbooks of those who travel in first class sleeping coaches, and the commission favors the division of passengers into three or four classes such as they have on European government railroads where class distinctions go naturally with an aristocratic form of government and a vast standing army officered by men who are allowed to exalt themselves above the masses in many annoying ways as a means of maintaining the dignity of the army uniform.

Class distinctions, as such, have no place in the United States and the railroads were compelled many years ago to give up almost altogether the distinctions between the service given to first, second and third class passengers. Reduced fares for immigrants to important points in the interior have always been made, but, in order to avoid friction, such passengers have been transported on special trains as far as the railroads could manage to do so. Every American citizen feels that he is as good as anybody else and is inclined to act up to his conviction. He may not choose to sleep in a Pullman car, but he almost invariably insists on getting a ticket that will entitle him to sleeping car privileges if he chooses to pay the extra charge.

In the early days of railroading in this country the system of classifying passengers and providing different standards of accommodation for each was tested and never worked well. Even the policy of some of the leading trunk lines in charging an extra fare on limited trains composed wholly of sleeping and drawing room coaches has always created more or less friction because it is almost a daily occurrence that some obstreperous American citizen demands his rights by getting on board one of these trains with nothing more than an ordinary first class ticket. To make money out of low fares for third class or immigrant passengers the railroads would have to lower the standard of the accommodation they now give to that which is furnished on the Continent of Europe.

This advice by the commission to the railroads that a substantial increase should be made in the rate paid by all passengers using sleeping or drawing room coaches furnishes another instance of the maddening uncertainty the railroads must meet when dealing in any way with the Interstate Commerce Commission. It was only months ago that this same commission ordered reductions in the sleeping car fares and made a ruling that the rates for upper berths should be substantially lower than for lower berths in ordinary sleeping cars. The public was well satisfied with this ruling and it was particularly pleasing because it gratified the innate sense of equality so widespread in this country which makes every citizen desire the best and get it whenever he can possilbly afford it. By hitting the average American citizen in his tenderest spot, that is by dividing him into social classes when traveling on American railroads, the general public may be induced to take more interest in the railroad side of these interminable disputes.

In justifying its refusal to do anything for the trunk lines east of Buffalo and Pittsburgh the commission seems to have based its judgment on the prosperity of two or three of them. Though the specific instances are not mentioned it is evident that the great success of the Lackawanna Railroad and the rapid rise in the earnings and the market value of the stock of the Reading Railroad within a few years led the commission to conclude that all the other railroads in the same territory would be equally prosperous if they had been equally thrifty. The commission hits the expenditure of money on fine terminal stations in New York City and Philadelphia very hard. As this affects the New York Central directly, the commission should have taken into account the extreme penuriousness of the same railroad in its provisions for the accommodation of passengers at Buffalo and many important intermediate points. This criticism of expenditures for passenger stations will not be relished by cities like Buffalo that have been waiting their turn for such improvements for more than a generation. The commission seems to be now even more at issue with the public than with the railroads. Freight rates are indirect levies, but passenger rates are direct taxation of the individual.

Western Mechanics—Skill and Knowledge.

The railroad mechanics of America have become so cosmopolitan that a visitor to different sections ought to meet with uniformity in ability, skill and production, but such is not the case. It was long the pride and boast of Western mechanics, machinists in particular, that they could do work without proper facilities that would vanquish the machinists of any other section. The philosopher Carlyle asserts that the striking difference between the savage and the civilized

man arises from the ability of the latter to handle tools. The crowning triumph of the Western mechanic lies in his striking ability to perform work creditably with inferior tools or without tools.

This is not the characteristic of all Western workmen, but it seems better developed there than elsewhere. Inferior mechanics are common enough in the West, but they do not generally pass muster as first-class men, for their shortcomings show out conspicuously where they are continually required to do work on their own judgment, without direction of gang boss or foreman. Perhaps this is the reason why Western machinists, as a rule, are so persistently adverse to admitting that one machinist can be better than another. The progress of applied mechanics has a constant tendency to develop special skill on the part of workmen, in putting complex machines together, and in handling and repairing them after they have been in operation.

There are machines and tools in every day use that require master touches of refined skill at the hands of the fitter, and the exercise of real ingenuity and judgment must be displayed in detecting causes of derangement after the machines have been at work. Yet it is difficult to convince the average machinist that the man who works with the power of his brain, who by thought, investigation and study has prepared himself to solve mechanical difficulties that others fail to understand, is entitled to more pay than the mere skillful mechanic with his brain never in evidence. Men who are otherwise sensible and considerate display no kind of liberality when such questions come before them. All at once they become zealous for uniformity. When it is applied to details of machine construction, uniformity is intensely desirable, but the spirit which attempts to reduce men's liability to uniform mediocrity cannot be too strongly repudiated.

The work of railroad machine shops is extremely varied and the greater part of it can be performed satisfactorily by men who possess no exalted order of mechanical ability. But on the other hand, special work occasionally arises which calls for the highest order of dexterity, besides the exercise of unerring judgment and keen sagacity. A complicated machine stops working and has to be repaired. A tool gets out of order whose anatomy is a mystery to nine-tenths of the machinists. Air pumps, hydraulic rams, pumps and jacks, steam hammers, pressure gauges, brake attachments, indicators, injectors and kindred articles are simple enough in their mechanism to those who are accustomed to working on them, but when such appliances get out of working order hundreds of miles away from the makers and have to be repaired without delay, the man who proves himself competent to do the work is a valuable personage in a machine shop and deserves more pay than the common mechanic.

For the repairing of intricate machines and tools, essentials of machine shops, whose operation is imperfectly understood even among good mechanics, special knowledge more than skill is requisite.

An air pump comes in working indifferently, is intermittent in its action, and seems to pound the cylinder head. A machinist who can work as closely as a mathematical instrument maker takes the pump apart and can perceive nothing wrong. The pistons are apparently in good order, the valves seem to be faultless, and the workman can change nothing with the probability of doing more harm than good. Still the pump pounds. Another machinist goes through the pump and previous investigation and study of such machines give intelligent direction to his examination and he quickly discovers that the trouble lies in the air valve having too much lift. Knowledge gives this man power. Knowledge and skill together have made him an expert in this particular line, and he is justly entitled to enhanced remuneration just as much as experts in other lines of scientific industry.

Traveling Engineers' Convention.

The Traveling Engineers' Association meet in convention in Chicago on September 15 and we anticipate that the meeting will bring forth the usual good work for which the organization has been celebrated since on January 9, 1893, a group of traveling engineers met in the office of Locomotive Engineering, New York, and raising the motto: "To Improve the Locomotive Engine Service of American Railroads," formed the Traveling Engineers' Association. The association started out with 53 charter members. The editor of this journal in commending the new organization to railroad men, referring to the motto wrote: "If that motto does not enlist the sympathy and support of every railroad officer in the country, it will be because that officer ought to go off the road into the ice business."

We do not remember any association that organized under better auspices than the Traveling Engineers and the good start seemed to start it along at a progressive pace it has never faltered on. It has always had excellent officers, and the fact of Mr. W. O. Thompson being secretary from the beginning has contributed in no small measure to the success and prosperity of the association.

In the last annual report a fine synopsis of all previous reports is published which gives a real history of what the association has done since it was formed. After exhaustive study of the work done at the various conventions we do not think that any subject of investigation that covers the motto, "To improve the Locomotive Engine Service of American Railroads," has been neglected, while the subjects of greatest importance for railroad interests have been kept repeatedly before the members. One of the greatest expenditures of a railroad is for fuel. It costs anywhere from fifteen to twenty cents per train mile for fuel alone, so it can readily be seen that efforts on the part of enginemen that would reduce the fuel consumption two or three pounds per mile would make a great difference to the expenses of running a railroad. That the Traveling Engineers have been keenly alive to the importance of this line of expense is proved by the fact that in the twenty-one conventions fuel saving subjects have been discussed twenty-seven times. That the subject is not considered exhausted is proved by the fact that of seven subjects up for discussion three of them relate to methods that result in economy of fuel.

Although the list of subjects for investigation and discussion at the twenty-second convention is short we are persuaded that it will be worked in such fashion as will make the meeting notable for its interest and usefulness. The growing trouble with most technical conventions is, that they attempt to do too much and find it necessary to hurry over important business in the closing hours. We congratulate the Traveling Engineers' Association that they have avoided this serious blunder in the coming convention.

Railroads as Manufacturers.

We recently heard the assertion made that railroad companies are better prepared to build their own steel cars at low cost than to contract for them with builders who make a specialty of building such cars.

This is a comparatively old question and broadly means, can railroad companies manufacture rolling stock as cheaply and as well as concerns that make a specialty of the business? We have long experience behind us to guide judgment concerning this question, and we do not believe that any railway company can manufacture the appliances they use so cheaply as they can be purchased in the open market.

We believe it is safe to assert that the railway companies which have been and are able to use the greatest proportion of the income earned for the purpose of paying interest, taxes and dividends, are those that have followed strictly the business of transporting passengers and freight and have left the business of manufacturing railway appliances to those who make that kind of production a specialty. It is necessary for most railroad companies to maintain shops for the repair of their rolling stock, but the more rigidly such establishments are confined

to a narrow line of operations the better it is for the financial prosperity of the company. It is often necessary to prevent expensive fluctuations of work in repair shops to keep the construction of a few new locomotives or new cars going on; but the company that undertakes to build new rolling stock for themselves in competition with manufacturers always pay dear for their enterprise.

It is a common practice for foreign railway companies to engage in the manufacture of their own equipment, even rails being rolled in mills belonging to the railway companies, but there is no doubt that in every case the equipment could be bought cheaper from those engaged regularly in the manufacture. The managers of railway shops, having no special means of cheap production, frequently cling to the making of locomotives, cars and even telegraph instruments, and they will boast that they can make the articles much cheaper than they can be bought in the open market, although no accurate method is ever tried to count the cost.

In no country has sub-division of manufacturing operations and the employment of special production methods, aided by special tools for the cheapening of manufacture, been carried to the same perfection as they have been brought to in America. Yet some railroad companies using antiquated machinery and ancient methods of operation will pretend that they can compete with up-to-date manufacturers. Happily they are rare on this side of the Atlantic. The wise users of machinery or rolling stock are those who buy from those who have given intelligent attention to the art of producing well-made goods at the least possible cost.

General Miller Vanquishes Brandeis.

To employ Louis D. Brandeis by the Interstate Commerce Commission as special counsel was a very injudicious proceeding, for it is notorious that Brandeis persecutes railroad interests every time opportunity offers. In a recent case he attempted to show that the railroads of the United States were too friendly with the Galena Signal Oil Company and were wasting money by using that company's goods. In the way of proof Mr. Brandeis alleged that the Isthmian Canal Commission had effected material savings by purchasing lubricants in the open market.

General Charles Miller, chairman of the board of the Galena-Signal Oil Company, contended that Mr. Brandeis was misrepresenting the case intentionally or otherwise, and in an interview with a representative of the *Wall Street Journal* said:

"As the Galena supplies lubricating oil for all the equipment on a large percentage of the mileage of the railroads in the United States and Canada and other foreign countries, we naturally feel we know something about the subject of lubrication.

"The railroads are our customers and they need the increase in rates. If the roads get their increase our oils will need no defense, for the roads know our products.

"We have just completed our answer to that portion of Mr. Brandeis' brief, which we are filing with the Interstate Commerce Commission. A casual reading of this should make it clear, even to the layman, that Mr. Brandeis has been misled by erroneous data.

"In his brief, Mr. Brandeis stated:

"'In the Eastern Advance Rate Case (1911, p. 305), the commission declared: 'But it should be further said that before any general advance can be permitted, it must appear with reasonable certainty that carriers have exercised proper economy in the purchase of their supplies . . . .'

"'There is reason to believe that on many of the railroads important economies may be effected through improvements in methods of selecting, purchasing and using supplies similar to those introduced by Colonel Goethals on the canal railroads.'"

"In support of his contention Mr. Brandeis quotes at length from the 1911 report of the Isthmian Canal Commission. Summarized his allegations and our statement of the facts are:

"Mr. Brandeis alleged that: Lubricating and illuminating oils and greases in the fiscal year 1910 cost $137,500 and in the year 1911 only $80,600.

"The Galena-Signal Oil Company did not furnish any oils to the Commission after June 30, 1908, nor to the Panama railroad after December 7, 1909, and for the respective last years only a total of $72,131. The comparison, therefore, is inaccurate and misleading.

"Mr. Brandeis alleged that: Decrease in cost of oil on the Panama railroad attained in spite of an increase in fuel consumption of about 13 per cent., which would naturally be accompanied by an increase in the use of lubricants.

"Fuel costs on the isthmus were about $6 per ton for coal and $1.10 per barrel for fuel oil. The increase in consumption in 1910-11, compared with 1908-09, was $1,278,610, with a decrease of nine locomotives and fourteen steam shovels in service. Therefore, the apparent decrease in cost of lubricants, with the enormous increase in fuel consumption, with less equipment in service, is so inconsistent that no further comment is necessary.

"Mr. Brandeis alleged that: (1) Saving of $30,000 was due to reduction in price of lubricants and receiving oil in iron drums instead of barrels and tins. (2) Saving of $20,000 was due to substituting cheap oils for high-priced oils on chains, and supervision by experts.

"(1) The Galena Signal Oil Company urged upon the Panama officials this reform as early as 1907-8, three years prior to its adoption, and if it had been adopted it would have made a reduction in the cost of oils sold by the Galena-Signal to the Commission of 6 cents to 7 cents per gallon. (2) The Galena Signal Oil Company offered the services of an expert repeatedly, but this offer was rejected. The railroads of the United States have been following this system for twenty or thirty years, the same having been instituted by the Galena-Signal Company. Therefore, these claimed economies were due to the adoption of Galena methods.

"Mr. Brandeis alleged that: The Canal Commission and Panama railroad are lubricating cheaper than railroads in the United States.

"The service on the isthmus consists of light equipment and mostly of switching and work train service, and cannot be compared with the railroads of the United States, and if coal consumption and repairs are considered it will be shown that the cost on the isthmus is much greater.

"Mr. Brandeis alleged that: Panama railroad locomotives are making fifty-three miles to a pint of cylinder oil and twenty-three miles to a pint of engine oil.

"The Galena Signal Oil Company can show records of many lines in the United States having heavy equipment and trains making average mileage much in excess of these figures. When Galena oils were used on the isthmus, Mr. Desborough, at Panama, reported making ninety miles to a pint of cylinder oil and forty-five miles to a pint of engine oil.

"Mr. Brandeis laid great stress on the placing of all equipment on a fixed daily or monthly lubricating oil allowance and the close supervision by traveling engineers.

"This system has been in vogue on the American railways for twenty to thirty years, through the instrumentality of the Galena-Signal Oil Company, and if the commission officials had accepted the services offered by the Galena when it was supplying the oil, the costs would have been very much reduced during that time, and for two or three years prior to the adoption in 1910-11.

"Mr. Brandeis alleged that: If the railroads in the United States were able to equal the figures on the isthmus, making allowance for service and size of equipment, it would be to their very material advantage, a benefit they could very justly attribute to the construction of the Panama canal.

"If comparative estimates were made by qualified experts as to the costs per unit of work, performed by the railroads, it would be found that the railroads in the United States are lubricating their equipment much cheaper than this service is performed on the isthmus. The in-

ference is that low-priced oils and the supervision given on the isthmus are set up as standards, whereas railroads in the United States have been following this practice of supervision for many years, and if a fair comparison were made with accurate statistics, considering character of service and comparative units of work performed, it would be demonstrated that the railroads in the United States are lubricating at a cost much less than is obtained on the isthmus."

Why Electric Locomotives Exert More Power than Steam Locomotives.

A valued correspondent working on a road that employs electric motors for certain work writes, saying that an electric locomotive will draw a heavier train than a steam locomotive, and wishes to know why this comes about. He holds that power applied to the drawbar ought to produce the same effect, be it originated by steam or electricity. He adds that the subject has been discussed frequently by the enginemen and that an impression prevails that some electric condition of the rails and wheels causes the difference, but he does not believe it. Good for our correspondent who hails from Baltimore.

There is no doubt that the difference in tractive power exists, but it comes about in this way: The rotative power applied to the wheels of an electric locomotive or motor is constant, whereas the power of the steam locomotive is intermittent. To make the difference plain we will suppose that the steam locomotive has a single cylinder and the power required to draw the train is 700 pounds. The force exerted by the pistons would be 0 when the crank was on the dead center and 1,100 pounds at the maximum, so that while the electric motor doing the same work would exert only 700 pounds toward turning the wheels, the steam locomotive, with one cylinder, would at times exert a force of 1,100 pounds.

It is true that steam locomotives are not worked by one cylinder, and at first sight it would seem that that makes a vast difference, and that with two cylinders the impulse to turn the wheels is almost constant; but even assuming the steam pressure to be constant, there is a vast difference in turning effort between the time that the pistons are nearest to the dead center and when they are nearest to the middle of their stroke with the cranks at the points of their maximum power.

To Avoid Growing Old

At the last convention of the Traveling Engineers' Association we were much struck with the youthful appearance of the members as a whole, for few of them were under forty years of age, an age considered by some authorities as being close on the limit of a man's active usefulness. Few railway companies will hire a man who has reached the age of forty years, which we consider a mistake, for at forty a man should be in his prime both mentally and physically. That a man has an aged appearance at forty is generally his own blame, and is due to habits that induce premature old age.

There is a vicious belief among workmen and others who have to work for a living, that it is good for their health to take all the ease that their duties will permit. The working hours of the ordinary shop, factory or office worker are not sufficiently long or arduous to call for hours of recuperation; yet it is the common practice for such people to imagine that protracted hours of leisure are necessary to prepare them for the labor of recurring days. As a matter of fact most of them are more in need of active recreation than they require lounging in inactive idleness. The person who keeps mind and body active during leisure hours is the person who reaches a green old age without infirmity or sickness.

Dr. Andrew Carnegie, the great capitalist and philanthropist, is seventy-seven years of age, but he is hale and hearty and looks more than ten years younger, a condition brought about by his leisure hours being filled with active duties and amusements. Golf and other forms of walking keep Dr. Carnegie young. Our own chief, Dr. Sinclair, though younger than Dr. Carnegie, surprises his friends at every convention by his youthful appearance, a result brought about by the same methods employed by Dr. Carnegie—active work, mental and physical.

A great deal of old age in this country is artificial. A man of forty should not show the least sign of artery hardening, or lack of coordination between brain and muscle. His creative faculty should be just as good as when he was twenty-five, and the added experience which only years can give should make him far more valuable to an employer than a man of twenty-five. He has discovered how to avoid mistakes and to make the best of every situation.

Coming back to the traveling engineers, we believe that as a body numbering over one thousand they are the best preserved men who gather together in the United States. They are naturally selected as the most representative of about 75,000 locomotive engineers, which covers Canada and Mexico besides the United States railroads which in 1913 were operated by 63,378 locomotives. The duties of traveling engineers, although not onerous or nerve-racking, keep the men active mentally and physically and account for the splendid appearance of these men. Few of them need to wander over golf links to keep them vigorous. Many other railroad men whose work is sedentary and apathy inspiring would reap substantial health stimulant by performing for a few months the duties of road foreman of engines.

Railroads for Alaska.

The United States Government is going to construct and operate a thousand miles of railroads in Alaska and has agreed to spend $35,000,000 of the people's money on that undertaking. Information concerning this enterprise has been widely disseminated and we are receiving inquiries from readers of RAILWAY AND LOCOMOTIVE ENGINEERING as to the parties they ought to apply to for positions on the railroads referred to.

We have no direct information on this subject, but from a recent issue of the *Locomotive Engineers' Journal* we learn that the Washington representatives of the Brotherhood of Locomotive Engineers, Messrs. Wills, Clark, McNamara and Fitzpatrick, have been making inquiries of the Hon. Franklin K. Lane, Secretary of the Interior, and received the following official statement concerning the matter:

"The details of this project have not been worked out, the route which the road will follow has not been selected, and personal matters in connection with the construction of the road have not as yet been taken up. This being so, of course there is no information available at this time as to train service positions to be open after the road is constructed, and I am quite sure that any such information that may have been given out did not come from an official source."

To our anxious inquirers who see fortunes in working on the government railroads in Alaska we would say go slow. There are restless railroad men all over the country who imagine that they see in every new railroad enterprise opportunities for advancement not to be found at home, which is generally a decided mistake. We have repeatedly known of cases where trainmen left good jobs to accept positions on railroads newly put into operation and discovered the work less congenial and the prospects of advancement much inferior to what they were on the road deserted.

The railroads in Alaska will be operated by United States Government officials and will be a novelty that does not appeal to railroad men who have always worked under private ownership. There are not a few government operated railways in the world and none of them is noted for efficiency in operation or fairness towards the employees.

We consider the United States Government is acting justly and fairly in undertaking the construction and operation of railroads in Alaska, for the country is sparsely settled and is altogether a tremendously large territory rich and full of prospects.

2-10-2 Locomotives for the Chicago, Burlington & Quincy

In the spring of 1912, the Baldwin Locomotive Works built five locomotives of the 2-10-2 type for the Chicago, Burlington and Quincy R. R. These were at that time the largest non-articulated locomotives in service. They have proved efficient and economical in handling heavy coal traffic, and ten additional locomotives generally similar in design have recently been constructed for this road by the same builders. The rated tractive force of all these locomotives is 71,500 pounds, and with equal hauling capacities and a large number of interchangeable detail parts they constitute a notable group of unusually large units.

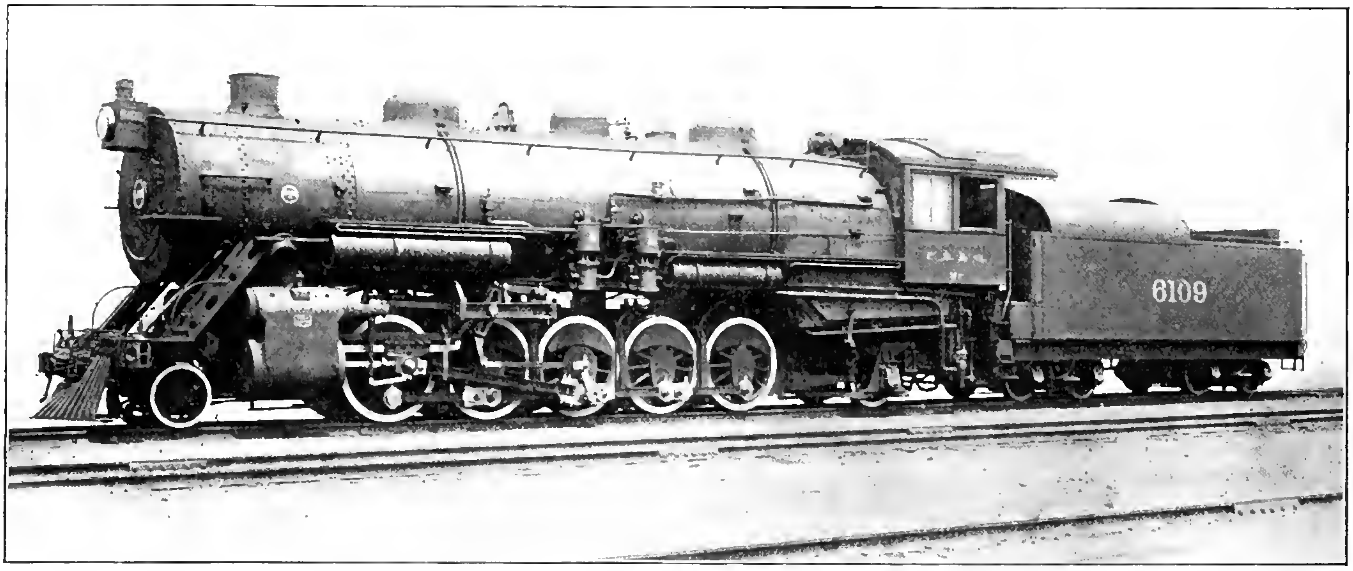
One of the most difficult problems in designing large locomotives with comparatively small driving wheels is to properly counterbalance the reciprocating and revolving weights. A number of eight and ten-coupled locomotives built by the Baldwin Locomotive Works have been fitted with counterweights keyed to the main axle, and these, in conjunction with the usual weights in the wheel centers, have balanced a sufficiently large proportion of the reciprocating and revolving parts to avoid destructive effects at the speeds at which these engines are run. This arrangement is used in eight of the ten new Burlington locomotives. In the two remaining locomotives the weights of the reciprocating parts have been sufficiently reduced by the use of special steels to avoid the necessity of applying additional counterweights. The locomotive illustrated herewith is one of the two equipped with the lighter parts.

The pistons of this locomotive have dished bodies of .40 carbon steel, annealed. These are riveted to cast iron bull rings, which are 6 ins. in width, widened to 8 ins. at the bottom to give ample bearing area. The packing rings are also of cast iron. The piston rods are of nickel-chrome steel, annealed. They have a diameter of 4¾ ins., with a 2½-inch diameter hole in the center. The crosshead is of the Laird type, with an unusually light section. The body is of .40 carbon steel, annealed, and the bearing shoe is of bronze. The piston rod has a taper fit in the crosshead, and is secured by an oil-tempered steel key, while the crosshead pin is of nickel steel. The main and side rods, stub straps, and main crank pins are of nickel chrome steel, annealed. The main pin has a 9-inch diameter fit in the wheel center, and is drilled with a 4-inch hole. The main driving-axle is of vanadium steel. All the rods are channeled to an I-section. The main and side rod stubs on the main pin are fitted with straps, and have a wedge adjustment for the brasses. The stubs are of the solid end pattern. The stubs on the second and fourth pairs of wheels are provided with knuckle joints, and the knuckle pins are fitted into spherical bushings of case-hardened steel. The bushing is held in place by a divided brass, which is fitted with a key for taking up wear. This construction allows the rods a limited amount of lateral flexibility. The lateral play between the wheel hubs and boxes is ⅜ in. for the front and back driving-wheels, and ⅛ in. for the main and intermediate pairs. The main driving-wheels have plain tires; on the second and fourth pairs there is a total play between rails and flanges of ⅝ in., while on the first and fifth pairs the play is ⅞ in. With these provisions for flexibility the locomotives can traverse curves of 21 degrees, notwithstanding the fact that they have a driving-wheel base of 20 ft. 9 ins.

The use of special materials, as described above, has effected a saving in weight of reciprocating parts on each side, amounting to 379 pounds, or sixteen per cent., as compared with the other locomotives using heavier parts. The balancing of the main wheels is greatly improved, and there is a material reduction in the amount of excess weight to be applied to the other wheels. The result is less wear and tear on the locomotive and track, while the lighter parts are more easily handled in the shop when making repairs.

The valve gear is of the Walschaerts pattern, controlled by the Ragonnet power reverse mechanism. The eccentric crank has been lightened to reduce the weight on the main pin. The crank weighs 125 lbs., as against 160 lbs. for the cranks used on the previous engines. The piston valves are 15 ins. in diameter, and are set with a lead of ¼ in. The cylinders are fitted with vacuum relief valves, but no by-pass valves are used.

The frames are 6 ins. wide, each main frame being cast in one piece with a single rail front section, while the rear sections are separate, and of slab form. The rear truck is of the Hodges type, and it is equalized with the fourth and fifth pairs of driving-wheels. The back truck spring hangers are pinned to brackets, which are bolted to the engine frames. These brackets, together with the foot plate, serve as supports for a wide expansion plate which carries the back end of the firebox. The front end of the firebox is also supported on an expansion plate. This is bolted to a steel casting, which supports the radius bar pin for the back truck, and also braces the frames at the splice between the main and rear sections.



2-10-2 TYPE OF LOCOMOTIVE FOR THE CHICAGO, BURLINGTON & QUINCY RAILROAD.
J. W. Cyr, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The boilers of the ten new locomotives are all alike. The firebox has a combustion chamber 28½ ins. long, and is equipped with a security sectional arch supported on four 3½-inch tubes. A street mechanical stoker is applied. The boiler shell has a straight top, but the third barrel ring has a slope on the bottom in order to provide a sufficiently deep water space under the combustion chamber. In this way the shell diameter is increased from 88½ ins. at the front ring to 100 ins. at the throat. The longitudinal seams on the barrel rings are all placed on the top center line. The main dome is placed on the second ring and the auxiliary dome on the third, and the seams on these rings are welded throughout their entire length. The main dome is of pressed steel, in one piece, measuring 33 ins. in diameter and 18 ins. in height. The opening under the auxiliary dome is 16 ins. in diameter, so that a man can enter the boiler to make an inspection, without dismantling the fittings in the main dome. The superheater is of the Schmidt top-header type, with 45 elements and a superheating surface of 1,232 square feet. With ample grate area and heating surface, mechanical stoking and high superheat this boiler is fully capable of supplying all the steam needed for the most severe class of service.

The continued use of this design of locomotive on the Burlington road, after thorough service tests of the locomotives built two years ago, indicates a more general adoption of the 2-10-2 type for heavy freight service. With 25 per cent. greater hauling capacity than a Mikado type locomotive carrying the same weight per pair of driving-wheels, this type will under favorable conditions effect a material reduction in the cost per ton mile of moving freight.

The following are the general dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.; cylinders, 30 ins. by 32 ins.; valves, piston, 15 ins. diameter.

Boiler—Type, straight; diameter, 88½ ins.; thickness of sheets, ⅞ in.; working pressure, 175 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 132 ins.; width, 96 ins.; depth, front, 89¾ ins.; depth, back, 75 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in.

Water Space—Front, 6 ins.; sides, 6 ins. to 4 ins.; back, 4 ins.

Tubes—Diameter, 5½ ins. and 2¼ ins.; material, 5½ ins., steel, 2¼ ins. iron; thickness, 5½ ins., No. 8 W. G.; thickness, 2¼ ins., No. 11 W. G.; number, 5½ ins., 45; 2¼ ins., 264. Length, 22 ft. 7½ ins.

Heating Surface—Firebox, 272 sq. ft.; combustion chamber, 68 sq. ft.; tubes, 4966 sq. ft.; firebrick tubes, 43 sq. ft.; total, 5,349 sq. ft.; grate area, 88 sq. ft.

Driving Wheels—Diameter, outside, 60 ins.; diameter, center, 52 ins.; journals, main, 12 ins. by 12 ins.; journals, others, 11 ins. by 12 ins.

Truck Wheels—Diameter, front, 33 ins.; journals, 6 ins. by 10 ins.; diameter, back, 42½ ins.; journals, 8 ins. by 14 ins.

Wheel Base—Driving, 20 ft. 9 ins.; rigid, 20 ft. 9 ins.; total engine, 40 ft. 1 in.; total engine and tender, 74 ft. 9¼ ins.

Weight—On driving wheels, 293,000 lbs.; on truck, front, 27,900 lbs.; on truck, back, 49,100 lbs.; total engine, 370,000 lbs.; total engine and tender, about 555,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. by 11 ins.; tank capacity, 10,000 gals.; fuel capacity, 15 tons; service, freight.

Locomotive equipped with Schmidt superheater.

Superheating surface, 1,232 sq. ft.

Making Parts Interchangeable.

One of the oldest metal industries was watch making, which exerted great influence upon the development of exact operations in machine work. The detailed mechanism of a watch are so small that it might be supposed that the makers of watches would have readily agreed to uniformity of parts, but the opposite tendency prevailed for many years among the pioneer watchmakers. Instead of working towards uniformity and interchangeability, the ancient watchmaker labored with much ingenuity to produce screws, for instance, that no other maker could readily reproduce. This tendency was followed by millwrights, blacksmiths and other users of screws and led to a deplorable condition in the machine trade, which was growing worse confounded when William Sellers first made the attempt to introduce uniformity in the design of screw threads. That really effected a beneficent revolution.

It used to be amusing to hear petty manufacturers prate about "our standard screws." Until the Master Car Builders' Association proceeded vigorously to advocate adoption of the Sellers screw threads, there were car manufacturers and locomotive builders that had standard systems of their own. Such people adhered rigidly to their own standard to the sorrow of those who had to do repairs. That has all been changed now, thanks to the action of the Master Car Builders' and Master Mechanics' Associations in adopting the Sellers dimension of screw threads. It might be well to explain that the interchangeable screw thread system was first brought out by William Sellers, of Philadelphia, in 1864 and was soon afterwards adopted by the Franklin Institute of Philadelphia and for a time thereafter was to many persons called the Franklin Institute System. Still later the Sellers system of screw threads and nuts was adopted by the United States Government and is now known as United States Standard.

This system of uniformity in screw threads, although advocated by highly influential supporters, made almost no progress into favor until it was adopted by the Master Car Builders' Association, which was done in the convention held at Richmond, Va., in 1871. From that time every car that had to be repaired away from the road of its owners, acted as an advertisement of the United States standard screw threads. It very soon became known from Maine to Texas that what was now the standard nuts and bolts of the association could be used in repairs of cars but no others. No invention ever received such stimulating influences into general adoption as the Sellers screw threads received from the Master Car Builders' Association.

In the previous year at a convention held in Philadelphia the Railway Master Mechanics' Association adopted the Sellers screw threads as a standard, which helped the cause of interchangeability. But as locomotives seldom go away from the railroad they belong to, the act of the Motive Power organization was not so far reaching as was that of the Master Car Builders.

The report of the Committee on Standard Nuts submitted to the Philadelphia convention in 1870 reveals a condition of the screw thread question that is interesting. The committee had sent out about one hundred circulars making inquiries for particulars of dimensions of nuts and bolts used by the members. About fifty replies were received and no two of the answers indicated the same practice. It was assumed that every railroad had a standard of its own. The committee did not think that having uniform nuts and bolts was of much consequence in the construction of locomotives; but they consented to the adoption of the United States standard screw threads. And that was no longer ago than 1870!

Buffalo Railway Terminals.

Railway terminal work in Buffalo, N. Y., calling for an expenditure of $15,000,000 to $17,000,000, will be placed under construction in the next year or two. Plans for a new station and other improvements for the Lehigh Valley, to cost about $5,000,000, have been approved by the Buffalo Terminal Commission. The Lehigh facilities will be shared by the Grand Trunk, Erie, Nickel Plate and Wabash. The New York Central lines are developing a scheme for a new terminal, which according to present plans will cost close to $10,000,000. In addition work is now progressing on the new Lackawanna station which will cost about $2,500,000.

Air Brake Department

Equipment A. M. M.

Following up a desire to illustrate the improvements that have been made in brakes for electric cars, we have some views of the Westinghouse A. M. M. equipment which is designed for trains of from one to three cars, and is especially adapted to high-speed interurban train service. It is also an efficient brake for electric locomotives or motor cars used in light switching service, as it provides for quick and flexible operation of the brakes on a single unit by straight air with the added facility of immediately changing to automatic operation when coupled to cars. This is a combined "automatic and straight air" brake and both features are incorporated in one brake valve. The brake valve is known as the M 22 and the operating valve of the equipment is the type M triple valve and an improved design of double check valve is used.

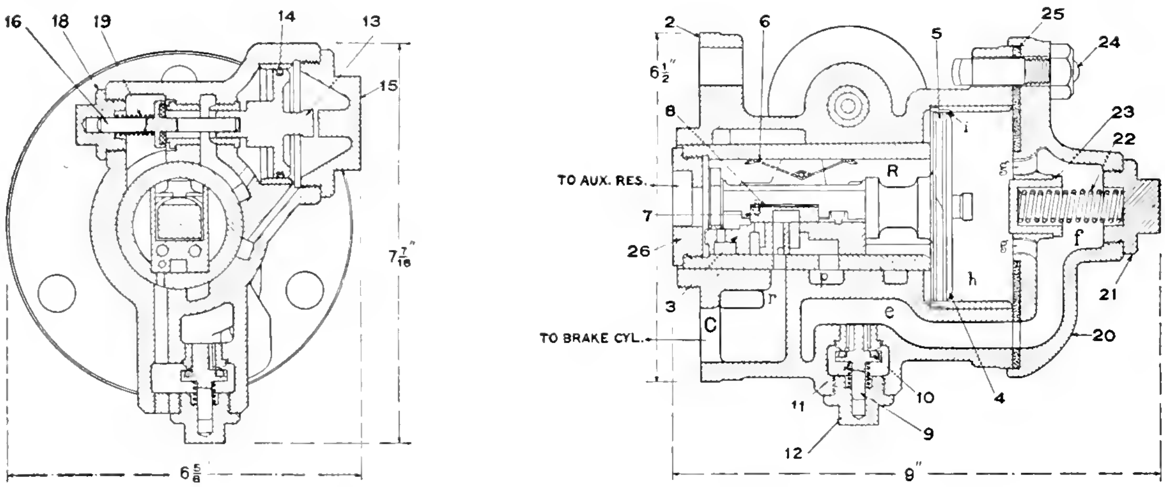
The triple valve is of the plain pipeless type, and in addition to the regular features of the plain triple, it contains quick service, quick recharge, graduated release and high pressure emergency.

The No. 14 double check valve has pipe connections to the brake cylinder, auxiliary reservoir, the triple valve connection on the brake cylinder head and to the straight air application and release pipe and air passes through this valve in applying brakes either in service or emergency or in straight air application.

The M 22 brake valve has six positions, namely, release, straight air lap, straight air application, automatic lap, automatic service and emergency.

The principal parts of the equipment are a motor driven air compressor, an electric compressor governor, a fuse box and snap switches, two main reservoirs, a safety valve, a feed valve, two duplex air gages, two brake valves, exhaust mufflers, a triple valve, a No. 14 double check valve, an auxiliary reservoir, a brake cylinder, a conductor's valve, and the usual cut-out cocks, air strainers, hose couplings, etc.

Next month we will describe the operation of the brake as well as it will be possible to do in a very limited space, compared with the features embodied in the brake equipment, but as instructions covering the operation of the equipments are always furnished to those interested a limited description here will suffice.



M-2-A TRIPLE VALVE—VERTICAL SECTIONS.

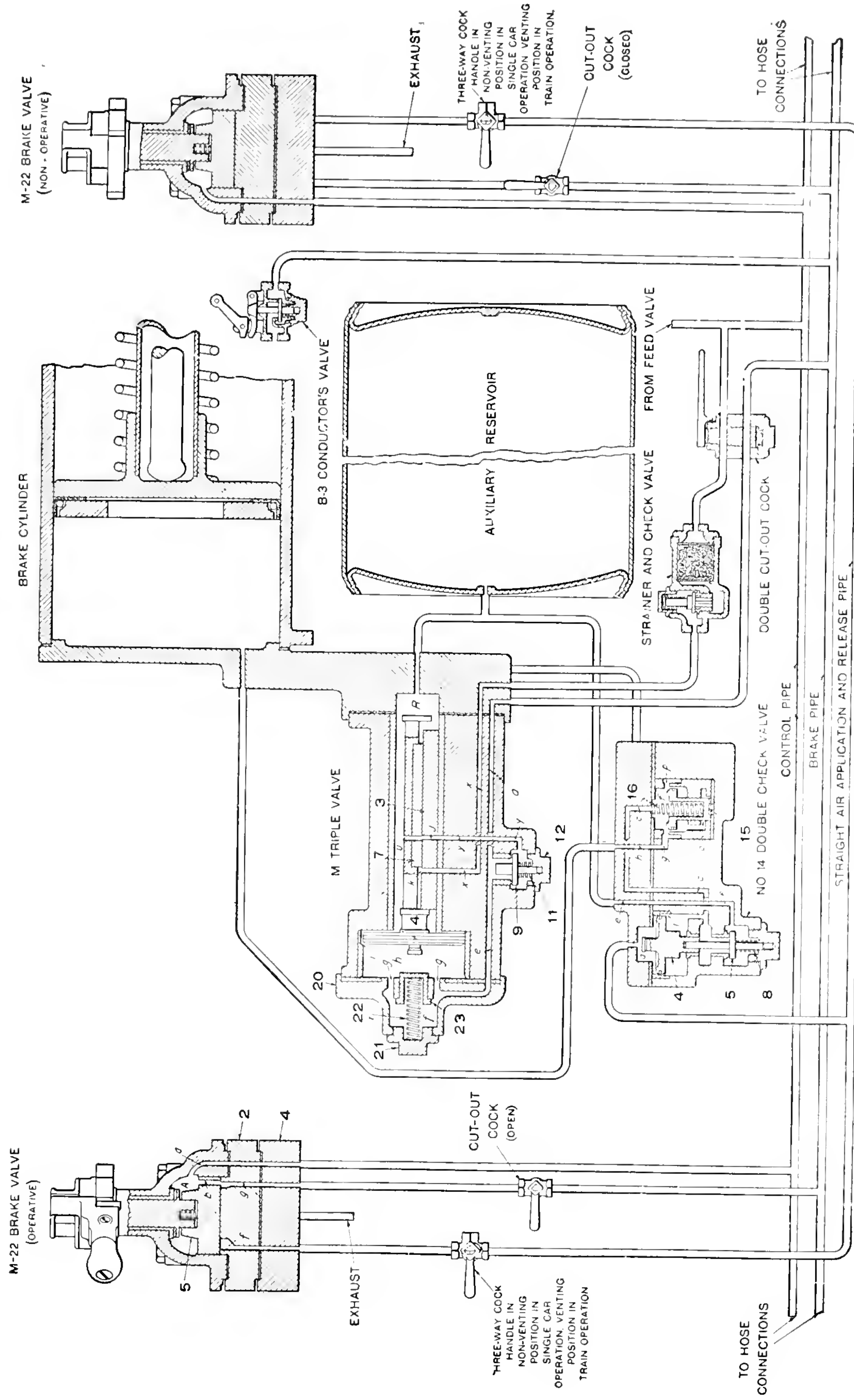
"Excess Pressure Governor Top."

The excess pressure governor top used with the E. T. equipment, principally for the purpose of maintaining main reservoir pressure at a figure 20 pounds higher than brake pipe pressure, regardless as to what the pressure may be, has in some instances been discarded from the locomotive. There are several reasons for this, as its use is not an absolute necessity, and if it is desired to maintain main resevoir pressure at a fixed figure a single top governor is all that is necessary; however, the majority of roads prefer a variable main reservoir pressure; that is, a reasonably low pressure when the brake is not in use and a much higher pressure for releasing and recharging the brakes. Under ordinary conditions this excess pressure top provides a practically perfect regulation of reservoir pressure and one of the chief features to which the most objection is offered is from another point of view the most desirable.

The operation of this governor is now so well known as to require no explanation and it is a well known fact that if brake pipe leakage at any time exceeds the capacity of the feed valve the governor will automatically throttle the compressor or entirely stop it.

If it is desired to run trains over the road with uncoupled hose and bursted brake pipes the governor top is very undesirable, but if the brake pipe is to be maintained free from excessive leakage so that the engineer can make the stop with the brake valve instead of brake pipe leakage making it, this governor top can be successfully used and it will be of some advantage to the engineer. By stopping the compressor it at once notifies the engineer that the leaks in the brake pipe are in excess of the feed valve capacity and it is then necessary to reduce the brake pipe leakage or run with the valve handle partially in release position; leaving a terminal with the valve handle in release position is not permissible, as it not only takes the train control away from the engineer, but there are circumstances under which, with the large capacity compressors, a train might be parted and the forward portion continue on for some miles before it would be discovered, whereas with the handle in the proper position this cannot occur without at least being indicated by the air gage.

This peculiarity of the governor in question necessitates charging a train with the brake valve handle in release position, and after waiting a reasonable length of time to charge the train and with the gage hands at about the figure of feed valve adjustment, should the compressor stop every time the handle is brought to run-

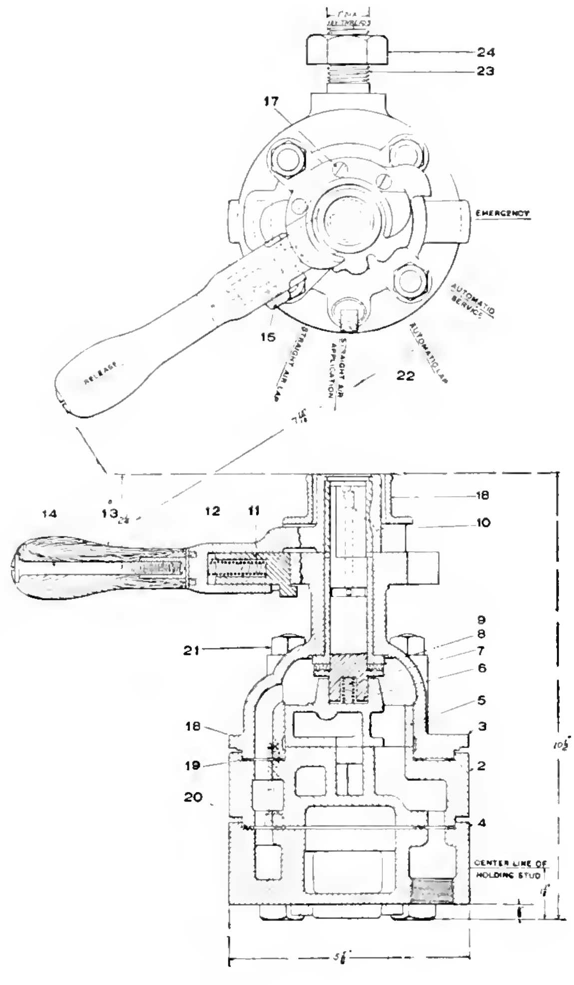


A. M. M. EQUIPMENT IN RELEASE.

ning position, it indicates that the pressure is still leaving the brake pipe faster than it can flow through the feed valve and it is certainly necessary to remedy the condition before the train is ready to proceed.

Restrictions are frequently found in the brake valve and feed valve parts, and in the piping on the locomotive, therefore if the train crew insists that there is no excessive leakage it will become necessary to make a feed valve capacity test.

This may be done by closing the brake valve cut-out cock and allowing the pressure to pump up to standard, then open the brake pipe to the atmosphere and with the engine brake released open the brake valve cut-out cock and note the fall of main reservoir pressure. The rate of drop will be in proportion to the main reservoir volume and with the average 70,000 to 80,000 cubic inch capacity reservoir, main reservoir pressure should fall 20 pounds in about 30 seconds if the feed valve is working at its maximum capacity, and if there is no restriction elsewhere. If however it requires 45 or 50 seconds to secure a 20 pound drop, the locomotive had better be taken back to the shop, because under such conditions no repairs could be made away from the shops.



M-22 BRAKE VALVE.

Should the compressor fail to stop during the test and thus interfere with it, it would at once indicate that there was a restriction in the brake valve or brake pipe and that because of it feed valve pipe pressure was being maintained at the feed valve adjustment, which could not occur if there had been the usual opening.

One defect of this governor which has caused more or less annoyance is the fit of the diaphragm valve in the spring box. It was formerly a practice to make this a neat sliding fit and when the brass became heated a slight expansion would cause the diaphragm to stick in the spring box. The correct way to remedy this is to ream out the spring box a trifle, but some repairmen developed the habit of reducing the diaphragm body with a file, which at times did not reduce the size the desired distance, so that if the pressure suddenly left the spring box the valve would lift high enough to stick. Under this condition the governor would operate perfectly on the lone engine, but when coupled to an uncharged train, a rapid change of pressure occurs, which may result in sticking the diaphragm valve open and holding the compressor shut down. After the train has been charged any ordinary defect of this governor or the feed valve will be indicated by the position of the hands on the air gauge. If, while running along the road, it was discovered that the compressor had stopped, the positions of the gage hands would be noted before any movement of the brake valve was made.

If the hands were found more than 20 lbs. apart with the brake pipe hand below the figure of the feed valve adjustment it would indicate that either a serious brake pipe leak had started or that the feed valve piston had stuck shut. If the handle is then moved to release position and the compressor starts it indicates brake pipe leakage, but if the compressor will not start it indicates that the feed valve piston is stuck. The reason the compressor will not start is that in release position of the brake valve the feed valve pipe pressure is governed by the feed valve and if it is closed the pressure in the spring box of the governor cannot be maintained.

Should a feed valve piston stick shut en route, or should the feed valve action become erratic enough to permit such wide variations in brake pipe pressure that the governor would hold the compressor inoperative for a sufficient length of time for brake application to occur, the brake valve handle can be moved toward release position just a sufficient distance to maintain brake pipe leakage and feed valve pipe pressure at the same time and thus keep the compressor in operation until such time as the necessary repairs can be made.

If, however, the compressor stops and the hands show that main reservoir and brake pipe pressures are less than 20 lbs. apart, it indicates that the governor is at fault, and the brake valve handle should be placed in lap position to cut out the excess pressure governor top, and if the compressor then starts and stops every time the handle is brought to running position, the gage hands being less than 20 lbs. apart, it points to a defective excess pressure top and the handle should be kept in lap position long enough to place a blind gasket in the operating pipe.

If the compressor will not start after the handle is placed on lap position it indicates that the maximum pressure top is at fault, or that the compressor is dry or broken down, and it would only be necessary to proceed according to standard instructions governing the location of the pump and governor troubles. In some instances the excess pressure governor connections have been changed so that the operating pipe is connected direct to the main reservoir instead of the brake valve, and if such happens to be the case it will conflict with the foregoing in that, when the valve handle is placed in lap position the excess pressure top will not be eliminated from the causes for compressor failing to start, but if the engineer will note while oiling the engine that the relief port of the governor is open before coupling to a train, he will have no diffi-

culty in determining whether the governor is holding the compressor throttled or whether it has stopped from some disorder in itself.

Storage Capacity of Passenger Brakes.

We frequently overhear remarks to the effect that with the advent of the large capacity air compressor, the tightening up of brake pipe leakage has been relegated to the lost arts, but be that as it may, there is, nevertheless, a heavy demand for the large compressor for both freight and passenger service. It cannot be disputed that these compressors are a necessity where trains of from 90 to 140 freight cars are being hauled in one train, because if there is to be any assurance whatever of a release of brakes on the rear end of the trains large capacity compressors must be used. With the long trains of today, main reservoir volume is a secondary consideration to proper air pump capacity.

As to whether the cross compound and duplex compressors are necessary for passenger service, a glance at the sizes of auxiliary, service, emergency and supplementary reservoirs on modern passenger cars will give a very fair idea of the type of air pump required. It is well known that nearly all terminals are equipped with storage plants and that during an application of train brakes either in full service or emegency, but a brake cylinder full of compressed air can be lost on applications regardless of the type of equipment, but there are many conditions under which a locomotive may be called upon to charge up a train of these cars.

In yard switching service many delays occur while trains of the cars are being charged, and as the general impression seems to prevail that 3 or 4 minutes is ample time for charging any passenger train with any kind of an air pump, it may be interesting to make an approximate estimate of the time required to charge a train of modern passenger cars with an 11-in. pump. Assuming that we have a train of 12 cars, that may have P. C., U. C., and single and double L. N. equipments, we would find, with an 18-in. L. N., one 16 x 42 auxiliary reservoir and one 22½ x 54 supplementary or two supplementary reservoirs with approximately the same capacity, namely, about 19,000 cu. ins., and with 7,300 in the auxiliary and at least 1,000 more in the brake pipe, we can find about 16 cu. ft. of space to be filled with compressed air on such a car.

An L. N. equipment of two 14-in. cylinders will have two 14 x 33 reservoirs, and two 20½ x 36 supplementary reservoirs, with a total of about 30,000 cu. ins. or about 17 cu. ft.

A P. C. 2-16 will have a 20½ x 36 service reservoir of 20,000 cu. ins., aud an emergency reservoir 16 x 48 of over 8,500, which with the brake pipe and pressure chamber will have about 12 cu. ft. of space to be filled.

The U. C. 16 will have a 20½ x 48 emergency reservoir of 14,000 cu. ins., one 4 x 33 service, a 10 x 33 auxiliary, and a 10 x 33 additional emergency reservoir, and in all about 13 cu. ft. of space to be charged on one of these cars.

An L. N. 16 will contain about 11 cu. ft., and a P. C. 2-14 or an L. N. 2-12 will contain approximately 9 ft. each, which will in itself give a good general idea of the demand upon an air compressor in charging these cars.

Assuming then that 12 cars averaging 13 cu. ft. each and no allowance whatever for train signal, water raising or lighting systems, 13 x 12, will mean 156 cu. ft. of space to be filled with compressed air for the brake system alone.

In 110 lbs. gage pressure there are 8.5 atmospheres, and to charge this train would require 7.5 atmospheres from the compressor or 156 x 7.5 = 1,160 cu. ft. of free air required.

It will be understood that the main reservoir pressure on the engine would not reduce the volume required, as that admitted to the brake pipe for recharging must necessarily be replaced before maximum pressure is attained, and in addition to this leakage must be taken into consideration.

Supposing an average leakage of 1½ lbs. per minute from the cars and locomotive, but considering for convenience the cars alone, at 110 lbs. pressure, 1-110 of 1,160 cu. ft., or a little over 10 cu. ft., would escape per minute, and at 1½ lbs. about 15 cu. ft. per minute would be lost.

If this was intended to be accurate in technical details, we would assume that one of the atmospheres could not escape through leakage, then it would be assumed that only a percentage of 7.5 atmospheres would escape, and with a little calculation it will appear that one pound per minute leakage means the same number of cu. ft. of free air expanded regardless of the pressure so long as the volume of the brake pipe does not vary. With an opening of fixed size, the higher the pressure the greater the number of cu. ft. of free air that can escape per minute, but where rate of leakage remains constant, it may be assumed that the loss in cu. ft. of free air is constant. As an example, at 70 lbs. pressure 4.7 atmospheres are free to escape under pressure, and 156 x 4.7 = 7,330, of which 1-70 is a little over 10 cu. ft., and similarly, at 30 lbs. pressure two atmospheres can escape through leakage when 156 x 2 = 312, of which 1-30 is also a little over 10 cu. ft.

As it is only desired to give an approximate estimate of the time required to charge one of these trains, the technicalities may be disregarded, and when an engine with an 11-in. pump is coupled to such a train, the recommended speed is 100 strokes per minute, and the capacity about 45 cu. ft. of free air per minute, and if the speed is increased, say to 130 strokes, which is nearly the maximum speed, with a 1-in. steampipe working against 100 lbs. air pressure with 200 lbs. steam pressure, the capacity of the pump may be increased to about 55 cu. ft., and if 15 ft. per minute is lost through leakage, the time required to charge this train of 12 modern cars, from 0 to 110 lbs., is 1,160 ÷ 40 (55 — 15), or = 29 minutes' time.

The rapidity with which modern passenger traffic is handled does not permit of 29 minutes' time for charging a train, for a brake test, therefore yard test plants are provided, even if they are not always accessible from all yard tracks, and where conditions may necessitate the charging of trains with yard or road engines, the advantage of the cross-compound compressor is readily observed, as it will easily compress 115 cu. ft. of free air per minute against 110 lbs. gage pressure with 200 lbs. steam pressure, so that in doing the work that required 29 minutes for the 11-in. pump the cross compound will consume but about 11½ minutes, or 1,160 ÷ 100 (115 — 15) = 11.6.

Teaching Children Manual Skill.

Agitation is constantly going on to teach the mechanical trades in common schools, which is a pernicious fallacy, for it would interfere with the literary instruction without giving valuable manual training. An innovation which has been introduced into some schools in New York City that aims at manual training is we think worthy of imitation. The majority of school children have no opportunity to go to the country in summer, and the school trustees have arranged to give them the opportunity of acquiring skill in manual operations.

On July 1 thirty-four schools were opened for pupils to engage in manual work. Most of the schools are in the congested districts. Instead of running wild, as they generally do during the school vacation periods, the children will have teaching in basketry, chair caning, bench work, and the household arts allied with sewing and cooking. Pupils who have not been promoted and those who are over age, besides foreigners who find difficulties with the language and children who wish to complete the allotted time of attendance required for working papers, will take the regular opportunities for schooling that are afforded. Also, there will be classes in the kindergartens.

There is no mental strain in this work. It merely regulates the normal activities of children. Periods of rest and recess are abundant. Proper arrangements can be made for the welfare of the teachers in overlapping periods of the year, or they may receive higher salaries, as they elect. It is improvident to permit the huge educational plant of the city to be idle during the summer months.

Mechanical Organizations and Their Work

By DR. ANGUS SINCLAIR

AIR BRAKE ASSOCIATION.

About twenty-five years ago the care of air brakes became such important work that agitation arose among railway men in favor of establishing an air brake organization where men particularly familiar with air brake mechanism might meet periodically and discuss subjects of mutual interest. This culminated in 1894 in the organization of the Air Brake Association, which has grown in numbers and influence so that its members are now considered the most influential officials regarding the operation and maintenance of air brakes.

The air brake has developed slowly from the simple apparatus that used straight air to push the shoes against car wheels, thereby controlling the speed of short trains in a very inefficient manner, to the modern automatic brake which does its work properly on any length of train and under the most trying conditions of speed and grades. Every advance made in train brake mechanism has been carefully studied by the Air Brake Association. Reports have been read about them and exhaustive discussions of details have served to keep railroad men generally informed on everything worth knowing about air brakes. The efficiency of the air brake and the extraordinary skill displayed in handling it has been due in a great measure to the intelligent labors of the Air Brake Association.

A few particulars of the work done at different conventions of the Air Brake Association will give you an idea of the proceedings of a particularly earnest and efficient body of experts.

At the first annual convention reports were read on Cleaning and Oiling Triple Valves, Air Pump Repairs; Maintenance of Freight and Passenger Train Brakes; and Handling Freight or Passenger Trains Wholly, or Partly Equipped witht Air Brakes.

At the second annual convention held at St. Louis in 1895 the following subjects were reported on and thoroughly discussed: Pump Governors and Air Gauges, Air Pump Piston, Care of Engineer's Brake Valve, Foundation Brakes, Care of Signal Apparatus and Conductor's Valve, Slid Flat Wheels, Driver and Engine Truck Brakes, Stack Adjusters, Handling Trains on Heavy Grades, Tests Made to Determine the Stopping Power of Engines Reversed, With and Without Use of Air Brakes.

The progress between the second and the twenty-first convention reveals an immense amount of valuable work performed. To give one an idea of the work done at the twenty-first convention held at Detroit in May last, I quote a synopsis of the proceedings issued by Secretary Nellis as follows:

Caboose Air Gauge and Conductor's Valve.—A spirited discussion followed the reading of this paper by Mr. Mark Purcell, some Eastern members believing such installation productive of more harm than good, the Western members and some Eastern members citing cases where accidents have been averted by an intelligent use of the devices. The discussion on the whole indicated that intelligently used, the devices were of the safety order and beneficial, but improperly used were detrimental.

Clasp Type of Foundation Brake Gear for Heavy Passenger Equipment Cars.—Mr. T. L. Burton made an excellent presentation of his subject. He showed clearly and cited cases, where certain types of clasp brakes proved less efficient than a single shoe type. Careful analysis of each individual case and scientific treatment of numerous details must be made to procure a highly efficient clasp brake. See proceedings for details.

Air Hose.—Mr. T. W. Dow, in presenting his paper, sought greater pliability than the present hose possessed. The discussion showed that the tendency of hose to absorb moisture, and freeze with attendant troubles, was the greatest fault at present. It was hoped that the new 1913 M. C. B. specifications might produce a betterment in this respect. Hand mounting versus machine mounting was discussed.

One Hundred Per Cent. Efficiency of Freight Train Brakes.—Mr. Von Bergen was not present to introduce and defend his paper; however, an active discussion brought out much to show why endeavor should be made to approach the ideal as near as possibly. Only constant and vigorous pounding could bring a close approach, it was believed, to reasonable efficiency.

Electro-Pneumatic Signal System for Passenger Trains.—Mr. L. H. Armstrong's paper was presented concisely and interestingly. It showed the great advantage of accurate signalling made possible by the assistance of electric current. Actual service tests on trains for five or six years were described.

Modern Train Building.—Mr. Geo. W. Noland, a yard service man, showed in his paper how break-in-twos could be avoided in a large degree by giving more intelligent attention to building up trains in yards, placing steel and steel underframe cars of greater weight on the head end, and older and lighter cars in a more protected position on the rear end. See Proceedings.

Development of the Air Brake.—Mr. W. V. Turner gave, as usual, an interesting and instructive lecture, illustrated by lantern slides, to one of his largest audiences. He began with the first plain triple valve idea and progressed to the most modern type "U" triple valve, holding his audience of over two hundred for more than three hours. Those who were privileged to hear him pronounced the lecture the best he has yet given.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.

For many years after railways were in operation, the master mechanic was superintendent, chief draftsman, general foreman and every other kind of foreman who was responsible for operations connected with the repair and management of rolling stock. The duties imposed upon the head of the rolling stock department gradually became too onerous and aids were established as the necessity arose in the form of traveling engineers, air brake experts, general foremen, etc.

The International Railway General Foremen's Association was organized in 1905 and at once became noted for the vigorous reports and discussions they carried on concerning shop repair work and the methods of performing repairs at the lowest possible expense. I have noticed at the Railway Master Mechanics Association Conventions, which I have attended for many years, a common practice was for certain members to seclude themselves away from the maddening crowd and exchange points of experience by which difficulties were overcome and work facilitated. I have always believed, that the information exchanged at these private interviews, were worth about as much as the instruction received from listening to the reading of reports and the discussions thereon.

From my intercourse with the proceedings of the General Foremen's Association, I am inclined to think that the individual members obtain as much valuable information by that process of exchanging notes of experience, as the Master Mechanics and Traveling Engineers do by the same process.

By mentioning a few of the reports and discussions of the same carried on

by the Railway General Foremen's Association, you may form a correct idea concerning the work they are performing.

During the first four of their Conventions, the General Foremen kept closely to the discussion of shop matters, but later they have ventured into a wider engineering field. I shall mention the subjects reported on and discussed at two Conventions which will suffice. In speaking of the work done by the General Foremen at their Conventions, I wish to testify to the earnestness manifested and the zealous way that the members attend the various sessions. Instead of holding Conventions for three days only, as is the usual custom, they extend the Convention over four or five days and hold two sessions each day. They are so ambitious to do a great deal of work that they sometimes discuss subjects that do not come within their natural jurisdiction—such as position of check valves.

The following subjects were reported upon and discussed at the Fifth Annual Convention:

1. Air Brake Equipment, including pumps and all classes of service.
2. Best method of arriving at cost of repairs.
3. Coaling of Engines with coaling machines.
4. How to obtain the quickest and best routine of handling engines.
5. Advisability of installing hot water wash out and filling systems.
6. The use of oxy-acetylene process of welding fire-boxes, boiler sheets, frames and other locomotive work.
7. Pouring of driving box brasses into driving-boxes.
8. Location of the point of water delivery.
9. Thermit Welding.

The discussions of all the subjects were remarkably exhaustive and highly practical.

Last year's convention kept up the reputation which the Association had earned. The topics reported on and discussed were:

1. Superheated Locomotives.
2. Apprenticeships.
3. Shop Schedules.
4. The Dispatch and Calendar Rule.
5. Driving Boxes.
6. Engine House Efficiency.

All these reports are excellent and it may seem invidious to select any for special commendation, but I can scarcely avoid giving praise to that on Superheated Locomotives which was prepared by Mr. P. C. Linck, general foreman, Chicago & Eastern Illinois Railroad.

The report on superheaters submitted to the Traveling Engineers' Association has been highly commended, but it was not more valuable than that prepared by Mr. Linck. The especially valuable features of the Traveling Engineers' report was in the practical information concerning the management of superheated locomotives, given to all persons connected with handling that type of engine. The report on Superheated Locomotives presented to the General Foremen's Association relates principally to the conducting of repairs of the same in the shops, and also to the disorders in operating likely to demand attention. It is, however, an admirable report of shop work skilfully carried out.

RAILWAY FUEL ASSOCIATION.

Besides the minor mechanical associations, there are a variety of others doing good work in limited lines, all of them deserving support from the higher officials of our railroad companies. The most important of these is the Railway Fuel Association, which has 642 members. Mr. D. R. McBain, superintendent of motive power of the Lake Shore & Michigan Southern, being president, aided by several influential railroad officials as vice president and executive committee. Mr. C. G. Hall, McCormick Building, Chicago, is secretary.

The principal work carried on by the Railway Fuel Association relates to the fuel used by railway companies and methods for using the same economically. Scientific combustion and heat conserving appliances have received searching investigation from the members. Some of the best reports on the combustion of coal ever published have been prepared by members of this association.

An Uncomfortable Night Journey.

In an article on "Evolution of Comfort in Railway Traveling," contributed by Angus Sinclair some years ago to the *Pall Mall Magazine* of London, the following amusing note of travel is related:

"At Port Jervis a six-foot-and-a-half lumberman enters a sleeper and is disgusted to find all the berths taken. Finds a seat in a day car and prepares to make himself as comfortable as circumstances will permit. Takes off his boots and rests his feet on his bag to keep them off the floor. After a brief trial, he finds his knees in the way and slides them up to the top of the seat in front. Body and legs now form an inverted N and he falls asleep. When the conductor rouses him half an hour later to ask for his ticket, he imagines that his neck is broken, but he has merely got cramps. He decides to try another plan, so he takes up his bag to use as a pillow. As he lays his cheek upon the bag he finds that it had picked up an abandoned chew. He says two or three times, and then takes out his knife and scrapes off the tobacco. After that he lies down and stretches his legs over into the aisle. "Comfort at last," he grunts, and has just fallen asleep, when a passenger comes along to take a drink and rouses him with the demand to take his long legs out of the passage. He raises them into a perpendicular position, like the draw of the Tower Bridge, until the person gets through going and returning. Again he goes to sleep, and has hardly begun to snore, when another passenger demands the right of way to the water cooler. By the time that eleven others have taken their turn, and the trainmen have claimed the right of way seven times, he decides that it is better to sit up.

"After a time he prevails upon a brakeman to turn the back of the seat next to his, which was empty. Taking his bag for a pillow, he curls himself into an irregular U, and occupies both seats. He is now comfortable, and dreams that he is visiting Florida; but presently the scene changes to the arctic regions, and he imagines himself searching for the North Pole. On awaking with a start, he finds that the passenger who went out at Corning had forgotten to close the door, and a zero wind is blowing in at forty miles an hour. He blesses the careless passenger as lumbermen bless, prepares to warm up with a drink, but finds that his bottle has got broken, and he remarks again — — — and walks in the aisle to renew his circulation. By the time he reaches Buffalo, he has made up his mind to adopt the practice of engaging a sleeper a month ahead or of staying at home."

To Redeem Iowa.

A worthy citizen of Iowa who feels aggrieved at some omissions and commissions of Iowa legislators writes congratulating our chief on having cut all connection with his old State. Our friend also drafts a form of petition which he proposes to use upon the present legislature. It reads:

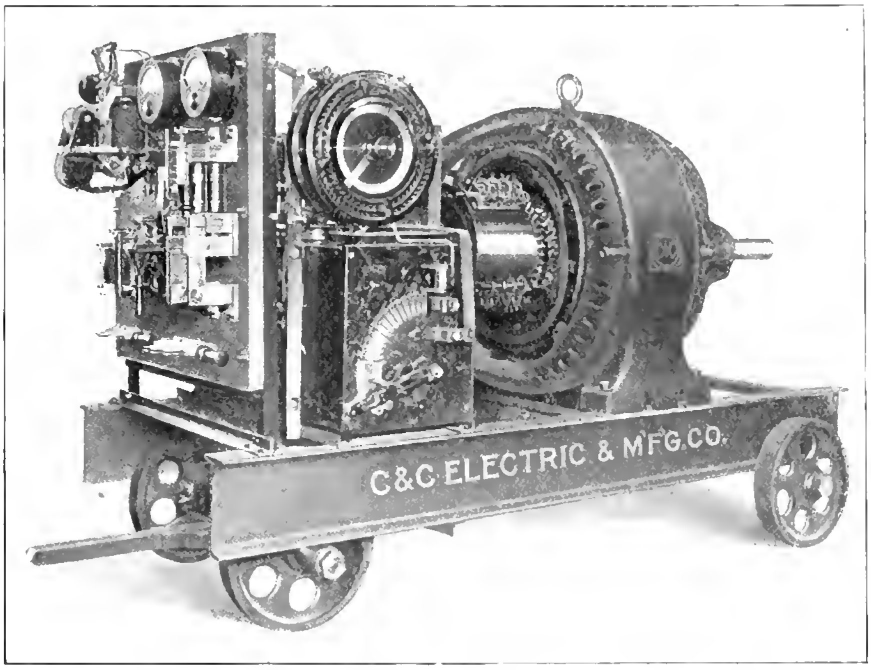
We, the principal citizens of Linn County, do hereby petition your honorable body to pass laws to hang all the druggists in the State; to abolish railroad companies and send their officers to the penitentiary; to provide a public guardian in each township whose duty will be to prevent any person from making a bad bargain; to compel banks and note shavers to lend money for two per cent. a year. Further we petition your august and honorable body to then adjourn and move out of the State and send the clerks of the committees to the orphans' home and all constables and other useless individuals to jail.

Electrical Department

Portable Arc Welder.

In one of our recent issues we described the process of arc welding and pointed out a few of its many applications to railway repair work.

Many times it is a great convenience to be able to move the arc welding apparatus to the "job" rather than moving the "job" to apparatus, and with this in mind the C. & C. Electric Company, of Garwood, N. J., have designed a portable arc welder, shown in the illustration, which has all the features of the larger stationary equipments. Extreme flexibility for welding and repair work is obtained and is of special advantage in ship yards, machine shops, locomotive shops and foundries.



MULTIPLE CIRCUIT PORTABLE ARC WELDER OF 200 AMPERE CAPACITY.

The apparatus, consisting of dynamotor, control apparatus and switchboard are supported on a base of I-beams and mounted on a heavy iron truck on wheels. The welding current is generated by a 110-volt dynamotor, the generator end having a capacity of 200 amperes at 70 volts. The motor shaft is extended for receiving a pulley for belt drive by gas, oil or steam engine when in use on barges, shop yards or where electric current is not available.

As illustrated the starting box and field control rheostat are mounted on the frame structure supporting the switchboard. The switchboard carries main line switch and circuit breaker for the motor, and automatic control relays for two individual welding circuits. A set of 400 amperes will provide for one graphite electrode or two metallic electrodes for welding. The graphite electrode gives a temperature of about 4,000 degs. C. and is used for cutting, preheating and welding with auxiliary bar. The metallic electrode for welding furnishes the welding metal directly and can be used on vertical or overhead work.

Electric Motors for Oil Wells.

The drilling of a petroleum oil well is a difficult undertaking. These wells, which vary from four to twenty inches in diameter and from one-half to three-quarters of a mile deep, must be kept free from sand, mud, etc., during the time of pumping which lasts many months. The steam engine has driven and pumped most of the wells, numbering nearly 200,000, but within the last three or four years electric motors have been used. The use of the electric motor was brought about more due to the drop in the price of oil than anything else. While prices were high the uneconomical use of the steam engine and gas engine did not appeal to the oil producer, but with lower prices the large savings in operating expenses due to the use of the electric motor are a factor. At first electric motors were developed for pumping an oil well that had previously been drilled, but later a drilling motor was built.

There are two modern methods of drilling oil wells, one the standard cable-tool method and the other the rotary process.

In cable drilling a heavy stem and bit is hung from a walking beam and is raised and dropped on the bottom. The drillings are mixed with water and removed by boiling. In the rotary process the bit is fastened to the lower end of a pipe which is rotated and is lowered as the drilling progresses. A mixture of thin mud is circulated down through the stem and up on the outside washing out the drillings and also plastering up the sides of the hole, thus preventing caving. As the hole progresses more and more power is required to turn the pipe, and this is where the electric motor is of advantage, for it is capable of developing high torque or turning power.

The advantages of electric operation can be summed up as follows:

The work is done faster, hence it is a time saver. The operating expenses are decreased and the production is increased, as the electric motor can be operated practically continuously without shutting down. Fire risks are reduced due to elimination of boilers.

The Carbon Incandescent Lamp—Its Manufacture.

Although the metallic tungsten lamp has partially replaced the carbon filament lamp, still there are a good many manufactured and the manufacture of the lamp is interesting, especially the filament, which process we will briefly describe.

The filament is made from a high grade cotton. This cotton is dissolved usually by a strong hot solution of zinc chloride and hydrochloric acid. At first the cotton forms sort of a jelly-like substance, but after standing for a few hours it is completely dissolved or absorbed by the solution and the result is a heavy syrup which is called cellulose. While still hot it is filtered to remove all impurities. After the solution has cooled it is placed in another jar which has a platinum die in the bottom. The die contains a small hole and the cellulose runs through this hole as a continuous thread, dropping into a jar containing wood alcohol. The wood alcohol solidifies the thread which is coiled in the bottom of the jar from which it is later removed and washed, and afterwards wound in large drums, about 4 ft. in diameter, and dried.

The next process is to carbonize the cellulose. This is accomplished by baking. The thread is wrapped on forms to give

it the proper shape and turns for the filament and is then embedded in charcoal or graphite and heated to 3,000 degs. C.

The filament is now formed, but to increase its efficiency it is treated or flashed. The filaments are cut to the correct length and then clamped in a receptacle from which the air has been removed and carboniferous gas, usually gasoline vapor, has been substituted. Electric current is passed through the filament, binging it up to a glow. The heat causes carbon to be deposited on the filament reducing the electrical resistance and increasing the mechanical strength.

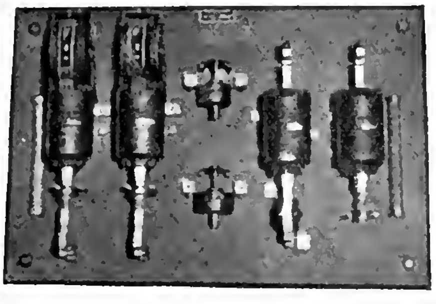
The filament is now completed and ready for assembly. It is mounted in a glass stem and connected to the leading in wires. The stem is then sealed into the bulb, after which the bulb is exhausted and sealed. The bases are then put in the lamp and it is ready for use.

Electrically Driven Planers.

The electric drive for machines has proven itself to be economical and most reliable and motors are being used on all kinds of machine tools.

The electric drive for planers, draw-cut shapers, slotters, gear cutters and similar machines has been worked up in detail by the Westinghouse Electric and Manufacturing Company and wonderful results are being obtained.

Direct connected motors are used, thus eliminating belts, tight and loose pulleys, and a positive and highly efficient drive is



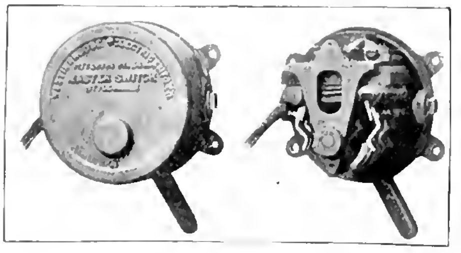
CONTROL PANEL.

obtained. With the elimination of the belts it is necessary to reverse the motor for the return speed.

The Westinghouse Electric & Manufacturing Company have designed a special motor for this kind of service. The complete equipment consists of a special motor and a controller which is operated automatically by the movements of the machine. It is possible to get the cutting and returning speeds adjusted within wide limits and each can be adjusted independently of the other. With motor drive it is thus possible to use the speed giving maximum production for all variations in length of stroke; depth of cut and weight on platen. Furthermore the tool is under accurate control; there is no slow down due to belt slippage under heavy loads and no expense for belt upkeep.

The apparatus consists of a motor, magnet-switch control panel, a master switch, a field rheostat and a resister for use in starting and stopping the motor. These parts are all separate for convenience in mounting in the most suitable manner. In addition to the above there can be installed a pendent switch for controlling the motor when adjusting the work, and an emergency brake control panel for automatically stopping the motor quickly on an overhead or on failure of the line voltage.

The motor must be of special design and very strongly built to withstand the



MASTER SWITCH.

severe service. The frame must be heavy and the bearing extra large. In order to cut down the flywheel effect the armature is built relatively small in diameter, which permits the motor to be started, stopped and reversed quickly.

The cycle of operation is as follows: When the master switch is tripped the motor is automatically started and accelerated to full speed. The starting is accomplished by the control panel which is made up of several magnet switches. These switches make the proper connections to the motor and automatically brings the motor up to speed step by step. It is impossible for these switches to operate wrongly as each is interlocked with the other and a definite cycle of operation is obtained. After the motor has started up the desired speed for both the cutting and reverse strokes is obtained by adjusting the field rheostats, which are connected alternately in the motor field circuit, one during the cutting stroke and the other during the return stroke. For the average planer the platen speed can be adjusted on the cutting stroke between 25 and 50 ft. per minute and on the return stroke between 50 and 100 feet per minute.

The master switch is mounted on the planer bed and tripped by dogs attached to the platen. A spring throws the drum to the forward or reverse position with a quick snap action.

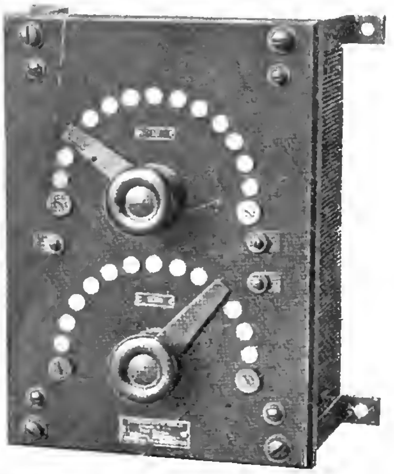
Paper Money Counted by Electricity.

The Buckley Bill-Counting Machine Company, of Washington, D. C., demonstrated recently at one of the large New York department stores an electrically operated machine for counting paper money. As the bills are sorted on the machine table they are drawn between rolls, counted and stacked into compartments. If two bills are stuck together the machine will stop until one of the bills is pulled out. To show the ingenuity of the device, a single folded bill will pass and be counted as one.

Each set of money-feeding rolls is connected with a magnet which operates the counter so that the separation of the rolls will operate the magnet and move the counter one step forward. The compartments receiving the bills are so arranged that the last counted money is separated from some previously counted.

The Electric Motor in the Agricultural Field.

It has only been comparatively a few years since the farmer has had any means of threshing grain. He was accustomed to the use of the flails, beating out the grain on the floor. The first step in advance of this was a horse-driven machine. Next came the substitution of the steam engine and later the gas engine for the horse. The electric motor has now entered the field and the number of applications should increase rapidly, for the first cost is lower, the operation costs less, and there is no danger of fire, due to elimination of cinders thrown from the smoke stack. An electric operated thresher will cost about $800, while a steam or gasoline engine of the same capacity will cost about $2,000. Results



FIELD RHEOSTAT PANEL.

from sets in operation show that the operating costs are approximately 25 per cent. less.

New York Subway.

The New York Public Service Commission, First district, will ask for bids on September 11 for the construction of Routes Nos. 43 and 26, the diagonal station at Forty-second street connecting the Lexington avenue subway with the existing subway at the Grand Central station. This contract extends from points in Park avenue near Thirty-eighth and Forty-first streets northerly to the north line of Forty-second street.

Items of Personal Interest

Mr. M. Carroll has been appointed general foreman on the Atlantic Coast Lines, with office at Tampa, Fla.

Mr. R. L. Chrisenberry has been appointed general foreman on the Southern, with office at Toeca, Ga.

Mr. E. Lakans has been appointed master mechanic on the Southern, with office at Birmingham, Ala.

Mr. E. P. Gray has been appointed general foreman on the Santa Fe, with office at Arkansas City, Kans.

Mr. A. M. Lawhar has been appointed general foreman on the Southern, with office at Princeton, Ind.

Mr. J. A. Wilking has been appointed general foreman on the Southern, with office at Birmingham, Ala.

Mr. G. N. MacDougald has been appointed signal engineer on the Virginia, with office at Norfolk, Va.

Mr. O. E. Male has been appointed storekeeper on the Wichita Valley, with office at Wichita Falls, Tex.

Mr. A. L. Gauthier has been appointed general foreman on the Boston & Maine, with office at Boston, Mass.

Mr. W. F. Norman has been appointed master mechanic on the Florida railway, with office at Live Oak, Fla.

Mr. A. Dallas has been appointed master mechanic of the Des Moines Union, with office at Des Moines, Ia.

Mr. J. J Herlihy has been appointed general foreman on the Baltimore & Ohio, with office at Cleveland, Ohio.

Mr. B. A. Eldridge has been appointed general foreman on the Santa Fe, with office at Arkansas City, Kansas.

Mr. C. A. Brown has been appointed master mechanic on the Toledo & Western, with office at Toledo, Ohio.

Mr. H. Y. Harris has been appointed master mechanic on the Tampa & Gulf Coast, with office at Odessa, Fla.

Mr. J. Coots has been appointed supervisor of locomotive operation on the Erie, with office at Jersey City, N. J.

Mr. C. Hill has been appointed master mechanic on the Live Oak, Perry and Gulf, with office at Live Oak, La.

Mr. O. Scruggs has been appointed chief dispatcher on the Denver & Salt Lake, with office at Denver, Colo.

Mr. F. M Jones has been appointed chief dispatcher on the Denver & Salt Lake, with office at Denver, Colo.

Mr G. F. Richards has been appointed general foreman on the Atlantic Coast Lines, with office at Lakeland, Ga.

Mr. H. F. Martyr has been appointed superintendent of motive power on the Arkansas Southeastern, with office at Randolph, Pa.

Mr. J. H. Penny has been appointed road foreman of engines on the Western Pacific, with office at Oroville, Cal.

Mr. A. P. Wall has been appointed master car builder on the Florida railway, with office at Live Oak, Fla.

Mr. M. J. Kehoe has been appointed electric engineer on the Ohio Electric Railway, with office at Lima, Ohio.

Mr. P. H. Lever has been appointed shop foreman of the Nevada Copper Belt railroad, with office at Mozon, Nev.

Mr. G. L. Dibble has been appointed general foreman on the Atlantic Coast Line, with office at Charleston, S. C.

Mr. A. S. Touhy has been appointed master mechanic on the Colorado & Wyoming, with office at Segundo, Colo.

Mr. D. Kavanagh has been appointed general storekeeper on the Western Maryland, with office at Hagerstown, Md.

Mr. M. L. Gray has been appointed general foreman on the Atlantic Coast Lines, with office at Charleston, S. C.

Mr. J. W. Hackett has been appointed master mechanic of the Houston Belt & Terminal, with office at Houston, Tex.

Mr. M. F. Kincaid has been appointed master mechanic on the Northern Pacific Terminal, with office at Portland, Ore.

Mr. W. C. Hayes has been appointed general foreman on the Detroit, Toledo & Ironton, with office at Ironton, Ohio.

Mr. C. H. Quinn has been appointed chief electrical engineer on the Norfolk & Western, with office at Roanoke, Va.

Mr. G. F. Callahan has been appointed general shop foreman on the Denver & Salt Lake, with office at Denver, Colo.

Mr. W. J. Hill has been appointed master mechanic on the Kansas Southwestern, with office at Arkansas City, Kans.

Mr. J. L. Armstrong has been appointed general foreman on the Santa Fe, with office at the Corwith Shops, Chicago, Ill.

Mr. P. C. Loux has been appointed road foreman of engines on the Baltimore & Ohio, with office at Lorain, Ohio.

Mr. G. A. Baals has been appointed road foreman of engines on the Chesapeake & Ohio, with office at Ashlan, Ky.

Mr. J. Bekrends has been appointed master machanic on the Houston & Brazos Valley, with office at Freeport, Tex.

Mr. J. P. Singleon has been appointed master mechanic on the Missouri, Oklahoma & Gulf, with office at Denison, Tex.

Mr. H. E. Chubbuck has been appointed general manager of the Chicago, Ottawa & Peoria, with offices at Peoria, Ill.

Mr. G. H. Kaiser has been appointed road foreman of engines on the Baltimore & Ohio, with office at Lorain, Ohio.

Mr. P. McClain has been appointed master mechanic on the Arkansas, Louisiana & Gulf, with office at Monroe, La.

Mr. W. Rife has been appointed signal supervisor on the Santa Fe, Prescott and Phoenix Lines, with office at La Junta, Col.

Mr. W. J. Eddington has been appointed general foreman at the Corwith shops of the Santa Fe, with office at Chicago, Ill.

Mr. John Hixson has been appointed master mechanic of the Kansas Southwestern, with office at Arkansas City, Kans.

Mr. F. C. Ferry has been appointed master mechanic on the Louisville, Henderson & St. Louis, with office at Cloverport, Ky.

Mr. J. A. Nunemacher has been appointed master car builder on the Louisiana Southern, with office at New Orleans, La.

Mr. P. M. Hammett has been appointed superintendent of motive power on the Portland Terminal, with office at Portland, Me.

Mr. C. Bach has been appointed foreman of water supply on the Chicago & North Western, with office at Bella Plaine, Ia.

Mr. W. J. Duffy has been appointed assistant road foreman of engines on the Baltimore & Ohio, with office at Wheeling, W. Va.

Mr. W. L. Wilson has been appointed foreman of the machine department on the Chesapeake & Ohio, with office at Peru, Ind.

Mr. L. H. Thacker has been appointed master mechanic on the San Benito & Rio Grande Valley, with office at San Benito, Tex.

Mr. George Searle has been appointed master mechanic on the San Pedro, Los Angeles & Salt Lake, with office at Las Vegas, Nev.

Mr. E. H. Mattingly has been appointed general foreman of the car department on the Baltimore & Ohio, with office at Garrett, Ind.

Mr. R. L. Brown has been appointed chief dispatcher on the Colorado Lines of the Denver & Rio Grande, with office at Pueblo, Colo.

Mr. R. H. Kautzky has been appointed master mechanic on the Des Moines Union, terminal road, with office at Des Moines, Iowa.

Mr. A. G. Kinyon has been appointed superintendent of locomotive operation on

the Seaboard Air Line, with office at Raleigh, N. C.

Mr. J. Hinds has been appointed master mechanic of the Grand Junction & Grand River Valley, with offices at Grand Junction, Colo.

Mr. E. E. Eichar has been appointed chief dispatcher on the Colorado Lines of the Denver & Rio Grande, with office at Pueblo, Colo.

Mr. E. W. Young has been appointed locomotive boiler inspector on the Chicago, Milwaukee & St. Paul, with office at Dubuque, Iowa.

Mr. A. R. Manderson has been appointed assistant superintendent of motive power on the Portland Terminal, with office at Portland, Me.

Mr. H. P. Smith has been appointed master mechanic on the Grand Junction & Grand River Valley, with office at Grand Junction, Colo.

Mr. E. J. Fulghum has been appointed superintendent of motive power on the Boyne City, Gaylord & Alpena, with office at Boyne City, Mich.

Mr. P. Simms has been appointed car foreman on the Puget Sound Lines of the Chicago, Milwaukee & St. Paul, with office at Miles City, Mont.

Mr. R. L. Schneider has been appointed general foreman of the car department on the Baltimore & Ohio, with office at Locust Point, Baltimore, Ind.

Mr. H. S. Williams, engine house foreman of the Grand Rapids and Indiana, at Grand Rapids, Mich., has resigned to become general foreman of shops of the Louisville, Henderson and St. Louis, at Cloverport, Ky.

Mr. J. E. Epler, formerly assistant to the general manager of the Chicago & Eastern Illinois, has been appointed superintendent of motive power on the same road, with offices at Danville, Ill. Mr. Epler succeeds Mr. J. H. Tinker, resigned.

Mr. William O'Brien has been appointed master mechanic of the Springfield division of the Illinois Central, with office at Clinton, Ill., succeeding Mr. Fred M. Baumgardner who resigned to accept service with the United States government.

Mr. A. J. Ironsides, formerly district master mechanic on the Manitoba division of the Canadian Pacific, at Saskatoon, Sask., has been appointed district master mechanic of the Alberta division, and Mr. H. Marshall has been appointed bridge and building master, both with offices at Edmonton, Alta.

Mr. T. R. McLeod, formerly master mechanic of the Canadian, Northern Ontario and the Bay of Quinte railways at Toronto, Ont., has been appointed division master mechanic of the Ontario Grand division of the Canadian Northern, Eastern lines, with headquarters at Toronto. Mr. R. A. Miller has been appointed general foreman and Mr. W. C. Moore has been appointed road foreman of engines of the Ottawa division, both with offices at Trenton; and Mr. J. W. Findlay has been appointed general foreman of the Toronto division, with office at Perry Sound, Ont.

Mr. James M. Gruber, who has been recently appointed president of the Minneapolis Western, has had a notable career as a railroad man. Graduating from Iowa City High School in 1885, he entered railway service in the same year as stenographer and clerk in the freight department of the St. Paul, Minneapolis & Manitoba railway, and in 1889 he was stenographer to the president of the Santa Fe at Chicago. In 1890 he entered the service of the Gulf, Colorado & Santa Fe, and from that year until 1897 he served in various capacities on the same road. In 1897 he was appointed general superintendent of the Montana Central at Green Falls, Mont. In 1903 he was superintendent of the western district of the Rock Island & Pacific at Topeka, Kans. In 1904 he was appointed general superintendent of the Union Pacific, and from February, 1905, to October, 1907, general manager of the Burlington & Quincy Lines east of the Missouri, and from October, 1907, to October, 1912, general manager of the Great Northern at St. Paul, and in the same year he was elected vice-president of the same road.

Obituary.

The death of Major J. G. Pangborn occurred on August 15, at Baltimore, Md., in his 71st year. At the time of his death

JOSEPH G. PANGBORN.

he was chairman of the general safety committee of the Baltimore & Ohio Railroad and had been employed by the company in various capacities for many years. He won distinction in the civil war, and then engaged in newspaper work, being for some time editor of the Kansas City *Times*. At the World's Fair in 1893 he was in charge of the railroad exhibits made by the Baltimore & Ohio. He was a constant contributor to the periodical press generally and the engineering journals, particularly. "The History of the World's Rail Way," "Sidelights on the World's System of Railways," were among his principal productions in book form. The former is an illustrated memorial volume of rare value, on account of the artistic colored reproductions of early locomotives with which it is profusely embellished.

Master Car Builders' Association.

Committees selected for the 1915 convention:

STANDING COMMITTEES.

1. Arbitration:

J. J. Hennessey (chairman), M. C. B., C. M. & St. P. Ry., Milwaukee, Wis.; T. W. Demarest, S. M. P., Penna. Lines, Ft. Wayne, Ind.; Jas. Coleman, S. C. D., Grand Trunk Ry., Montreal, Can.; M. K. Barnum, G. M. I., B. & O. R. R., Baltimore, Md.; F. W. Brazier, S. R S., N. Y. C. & H. R. R. R., New York City.

2. Revision of Standards and Recommended Practice:

T. H. Goodnow (chairman), A. S. C. D., C. & N. W. Ry., Chicago, Ill.; W. H. V. Rosing, assistant to V.-P., St. L. & S. F. R. R., St. Louis, Mo.; C. E. Fuller, S. M. P., Union Pacific R. R., Omaha, Neb.; A. R. Ayers, C. M. E., N. Y. C. Lines, Chicago, Ill.; O. C. Cromwell, M. E., Balto. & Ohio R. R., Baltimore, Md.; O. J. Parks, G. C. I., Penna. Lines, Ft. Wayne, Ind.; R. E. Smith, G. S. M. P., Atlantic Coast Line R. R., Wilmington, N. C.

3. Train Brake and Signal Equipment:

R. B. Kendig (chairman), G. M. E., N. Y. C. Lines, New York City; B. P. Flory, S. M. P., N. Y. O. & W. R. R., Middletown, N. Y.; J. M. Henry, S. M. P., Penna. R. R., Pittsburgh, Pa.; L. P. Streeter, air brake engr., Ill. Cent. R. R., Chicago, Ill.; R. B. Rasbridge, C. C. I., Phila. & Reading Ry., Reading, Pa.; W. J. Hartman, Air Brake Inst., C. R. I. & P. Ry., Chicago, Ill.; A. J. Cota, M. M., C. B. & Q. R. R., Chicago, Ill.

4. Brake Shoe and Brake Beam Equipment:

Chas. H. Benjamin (chairman), Purdue University, Lafayette, Ind.; C. D. Young, eng. tests, Penna. R. R., Altoona, Pa.; R. B. Kendig, G. M. E., N. Y. C. Lines, New York City; J. F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.

5. Couplers:

R. L. Kleine, C. C. I., Penna. R. R., Altoona, Pa.; G. W. Wildin, M. S., N. Y.

N. H. & H. R. R., New Haven, Conn.; F. W. Brazier, S. R. S., N. Y. C. & H. R. R. R., New York City.; F. H. Stark, Supt. R. S., Montour R. R. Co., Coraopolis, Pa.; J. F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; B. Julien, G. F. C. D., Union Pacific R. R., Omaha, Neb.; J. W. Small, S. M. P., S. A. L. Ry., Portsmouth, Va.

6. Loading Rules:

A. Kearney (chairman), A. S. M. P., N. & W. Ry., Roanoke, Va.; A. B. Corwith, G. C. I., A. C. L. R. R., Wilmington, N. C.; L. H. Turner, S. M. P., P. & L. E. R. R., Pittsburgh, Pa.; R. L. Kleine, C. C. I., Penna. R. R., Altoona, Pa.; J. M. Borrowdale, S. C. D., Ill. Cent. R. R., Chicago, Ill.; C. N. Swanson, S. C. S., A. T. & S. F. Ry., Topeka, Kan.; G. H. Gilman, M. C. B., Northern Pac. Ry., St. Paul, Minn.

7. Car Wheels:

W. C. A. Henry (chairman), S. M. P., Penna. Lines, Columbus, Ohio; A. E. Manchester, S. M. P., C. M. & St. P. Ry., Milwaukee, Wis.; R. W. Burnett, G. M. C. B., Can. Pac. Ry., Montreal, Can.; R. L. Ettenger, C. M. E., Southern Ry., Washington, D. C.; J. A. Pilcher, M. E., N. & W. Ry., Roanoke, Va.; O. C. Cromwell, M. E., B. & O. R. R., Baltimore, Md.; P. P. Mirtz, M. E., L. S. & M. S. Ry., Cleveland, Ohio.

8. Safety Appliances:

D. F. Crawford (chairman), G. S. M. P., Penna. Lines West, Pittsburgh, Pa.; C. E. Fuller, S. M. P., Union Pac. Ry., Omaha, Neb.; Joseph L. Hainen, G. S. M. P. & E., Southern Ry., Washington, D. C.; O. J. Parks, G. C. I., Penna. Lines, Ft. Wayne, Ind.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.; H. Bartlett, G. S. M. P., B. & M. R. R., Boston, Mass.; W. O. Thompson, M. C. B., N. Y. C. & H. R. R. R., Buffalo, N. Y.

9. Car Construction:

W. F. Keisel, Jr. (chairman), A. M. E., Penna. R. R., Altoona, Pa.; A. R. Ayers, G. M. E., N. Y. Central Lines, Chicago, Ill.; S. G. Thomson, S. M. P. & R. E., Phila. & Reading R. R., Reading, Pa.; C. E. Fuller, S. M. P., Union Pacific R. R., Omaha, Neb.; H. H. Vaughan, asst. to v.-p., Can. Pac. Ry., Montreal, Can.; E. G. Chenowith, M. E., C. R. I. & P. Ry., Chicago, Ill.; J. C. Fritts, M. C. B., D. L. & W. R. R., Scranton, Pa.; T. M. Ramsdell, M. C. B., O.-W. R. R. & Nav. Co., Portland, Ore.; C. L. Meister, M. E., Atlantic Coast Line R. R., Wilmington, N. C.

10. Specifications and Tests for Materials:

C. D. Young (chairman), engr. tests, Penna. R. R., Altoona, Pa.; J. R. Onderdonk, engr. tests, Balto. & Ohio R. R., Baltimore, Md.; J. J. Birch, D. C. I., Norfolk & Western Ry., Roanoke, Va.; I. S. Downing, G. M. C. B., C. C. C. & St. L. Ry., Indianapolis, Ind.; E. P. Tilt, engr. tests, Can. Pac. Ry., Montreal, Can.; Frank Zeleny, engr. tests, C. B. & Q. R. R., Aurora, Ill.; G. M. Davidson, chemist and engr. tests, C. & N. W. Ry., Chicago, Ill.; A. Copony, M. C. B., Grand Trunk Ry., Chicago, Ill.; A. H. Fetters, M. E., Union Pacific Ry., Omaha, Neb.; J. W. Taylor, secretary, Chicago, Ill.

SPECIAL COMMITTEES.

11. Car Trucks:

J. T. Wallis (chairman), G. S. M. P., Penna. R. R., Altoona, Pa.; E. W. Pratt, A. S. M. P., C. & N. W. Ry., Chicago, Ill.; Jas. Coleman, S. C. D., Grand Trunk Ry., Montreal, Can.; J. J. Tatum, S. F. C. D., B. & O. R. R., Baltimore, Md.; Prof. E. C. Schmidt, University of Illinois, Urbana, Ill.; L. C. Ord, G. C. I., Can. Pac. Ry., Montreal, Can.; J. McMullen, M. S., Erie R. R., Meadville, Pa.

12. Prices for Labor and Material:

F. H. Clark (chairman), G. S. M. P., B. & O. R. R., Baltimore, Md.; G. E. Carson, D. M. C. B., N. Y. C. & H. R. R. R., W. Albany, N. Y.; C. F. Thiele, G. C. I., P. C. C. & St. L. Ry., Columbus, Ohio; Ira Everett, G. F. C. R., Lehigh Valley Ry., Packerton, Pa.; H. H. Harvey, G. C. F., C. B. & Q. R. R., Chicago, Ill.; C. N. Swanson, S. C. S., A. T. & S. F. Ry., Topeka, Kan.; Samuel Lynn, M. C. B., Pitts. & Lake Erie R. R., Pittsburgh, Pa.

13. Train Lighting and Equipment:

T. R. Cook (chairman), A. E. M. P., Penna. Lines, Pittsburgh, Pa.; C. A. Brandt, A. M. M., C. C. C. & St. L. Ry., Indianapolis, Ind.; Ward Barnum, elec. engr., L. & N. R. R., Louisville, Ky.; J. H. Davis, elec. engr., B. & O. R. R., Baltimore, Md.; C. H. Quinn, A. E. M. P., N. & W. Ry., Roanoke, Va.; D. J. Cartwright, elec. engr., Lehigh Valley R. R., So. Bethlehem, Pa.; E. W. Jansen, elec. engr., Illinois Central R. R., Chicago, Ill.

14. Nominations:

F. W. Brazier (chairman), S. R. S., N. Y. C. & H. R. R. R., New York City; A. W. Gibbs, C. M. E., Penna. Lines, Philadelphia, Pa.; F. H. Clark, G. S. M. P., B. & O. R. R., Baltimore, Md.; F. F. Gaines, S. M. P., Cent. of Ga. Ry., Savannah, Ga.; J. J. Hennessey, M. C. B., C. M. & St. P. Ry., W. Milwaukee, Wis.

15. Arrangements:

D. F. Crawford, G. S. M. P., Penna. Lines West, Pittsburgh, Pa.

16. Tank Cars:

A. W. Gibbs (chairman), C. M. E., Penna. Lines, Philadelphia, Pa.; Thos. Beaghan, Jr., M. C. B., Union Tank Line, New York City; J. W. Fogg, M. M., B. & O., Chicago Ter. Ry., Chicago, Ill.; C. E. Chambers, S. M. P., C. R. R. of N. J., Jersey City, N. J.; Wm. Schlafge, G. M. S., Erie R. R., New York City; C. A. Shoemaker, G. S., German-American Car Lines, East Chicago, Ind.; J. S. Sheafe, M. M., B. & O. R. R., Staten Island, N. Y.

17. Settlement Prices for Reinforced Wooden Cars:

J. McMullen (chairman), M. S., Erie R. R., Meadville, Pa.; H. G. Griffin, G. C. I., Can. Pac. Ry., Montreal, Can.; T. J. Burns, M. C. B., Mich., Central Ry., Detroit, Mich.; J. T. Mehan, asst. to M. C. B., C. M. & St. P. Ry., W. Milwaukee, Wis.; H. H. Harvey, G. C. I., C. B. & Q. R. R., Chicago, Ill.; C. N. Swanson, S. C. S., A. T. & S. F. Ry., Topeka, Kan.; F. F. Gaines, S. M. P., Cent. of Ga. Ry., Savannah, Ga.

18. Compensation for Car Repairs:

D. F. Crawford (chairman), G. S. M. P., Penna. Lines West, Pittsburgh, Pa.; F. F. Gaines, S. M. P., Cent. of Ga. Ry., Savannah, Ga.; M. K. Barnum, G. M. I., B. & O. R. R., Baltimore, Md.; C. E. Fuller, S. M. P. & M., Union Pacific R. R., Omaha, Neb.; C. F. Giles, S. M., Louisville & Nashville R. R., Louisville, Ky.; Thos. Beaghan, M. C. B., Union Tank Line, New York City; H. L. Osman, S. C. D., Morris & Co., Chicago, Ill.; M. F. Covert, A. M. C. B., Swift Refr. Trans. Co., Chicago, Ill.

19. Draft Gear:

J. F. DeVoy (chairman), A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; W. E. Dunham, supr. M. P. & M., C. & N. W. Ry., Winona, Minn.; E. A. Gilbert, genl. insp. M. P., So. Pac. Co., San Francisco, Cal.; J. R. Onderdonk, M. E., B. & O. R. R., Baltimore, Md.; A. R. Kipp, M. S., M. St. P. & S. S. M. Ry., Fond du Lac, Wis.; G. W. Rink, M. E., C. R. R. of N. J., Jersey City, N. J.; P. F. Smith, Jr., S. M. P., Penna. Lines West, Toledo, Ohio.

20. Joint Meetings—Master Car Builders' Association and American Railway Master Mechanics' Association:

From the Master Car Builders' Association—R. W. Burnett, G. M. C. B., Can. Pac. Ry., Montreal, Can.; J. S. Lentz, M. C. B., L. V. R. R., South Bethlehem, Pa.; T. H. Goodnow, A. S. C. D., C. & N. W. Ry., Chicago, Ill.

From the American Railway Master Mechanics' Association—J. F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; C. E. Chambers, S. M. P., C. R. R. of N. J., Jersey City, N. J.; C. F. Giles, S. M., L. & N. R. R., Louisville, Ky.

RAILROAD NOTES.

The Baltimore & Ohio will place additional orders for 15,000 tons of rails.

The Southern Pacific has ordered 40 passenger cars from the Pullman Company.

The Grand Trunk has ordered six locomotives from the Montreal Locomotive Works.

The Chicago, Milwaukee & St. Paul is considering building new roundhouse at Beloit, Wis.

The New York Municipal Railways are in the market for 100 steel cars for subway operation.

The Cleveland, Cincinnati, Chicago & St. Louis is in the market for five Pacific type locomotives.

The Pittsburgh & Shawmut has ordered 25 box cars from the American Car & Foundry Company.

The Toledo & Ohio Central has ordered 1,000 freight cars from the Haskell & Barker Car Company.

The Louisiana & Arkansas has purchased seven acres near Jonesville, La., as a site for repair shops.

The Inter-Mountain, it is reported, has ordered four locomotives from the Lima Locomotive Corporation.

The Delaware, Lackawanna & Western has ordered 500 gondola cars from the Pressed Steel Car Company.

The Grand Rapids & Northwestern has placed an order for locomotives with the Baldwin Locomotive Works.

The Bangor & Aroostook has ordered five consolidation locomotives from the American Locomotive Company.

The San Diego & Arizona has ordered a consolidation locomotive from the American Locomotive Company.

The Cincinnati, Hamilton & Dayton is said to be in the market for 30 Mikado and 5 Pacific type locomotives.

The Pacific Great Eastern has ordered 40 steel underframe flat cars from the Canadian Car & Foundry Company.

The St. Louis, Brownsville & Mexico has placed an order for 15 passenger cars from the American Car & Foundry Company.

The Northwestern Pacific is in the market for 11 coaches, 4 baggage cars, 3 smoking cars, 4 chair cars and 3 mail and express cars.

The San Diego & Arizona has placed an order for 1,200 tons of material for a viaduct with the Llewellyn Iron Works, San Francisco.

The Paducah & Illinois has ordered 18,000 tons of steel from the American Bridge Company, to be used in its new bridge at Metropolis, Ill.

The Duluth, Missabe & Northern has ordered 251 tons of steel from the American Bridge Company for a connecting trestle at Duluth, Minn.

The Erie has ordered 200 gondola cars from the Standard Steel Car Company. It is said that this road will soon place orders for 600 more cars.

The Delaware, Lackawanna & Western has ordered 96 suburban coaches and 14 combination baggage and smoking cars from the Pullman Company.

The Chicago, Milwaukee & St. Paul has ordered 20 Mikado locomotives from the American Locomotive Company. They will be equipped with superheaters.

The Atchison, Topeka & Santa Fe has given Henry Bennett & Sons, Topeka, Kan., a contract for an engine house at Albuquerque, N. M., to cost $100,000.

The Minneapolis & St. Louis has ordered two postal cars from the Pullman Company. This read is said to be in the market for 500 gondolas and 750 box cars.

The Denver Union Terminal Company has opened bids for remodeling and enlarging the union station at Denver, Colo. This is first work undertaken in connection with terminal improvements that will cost $4,000,000.

The South Dakota Central has ordered two consolidation locomotives from the American Locomotive Company. They will have 20 by 24 in. cylinders, 51 in. driving wheels and a total weight in working order of 138,000 lbs.

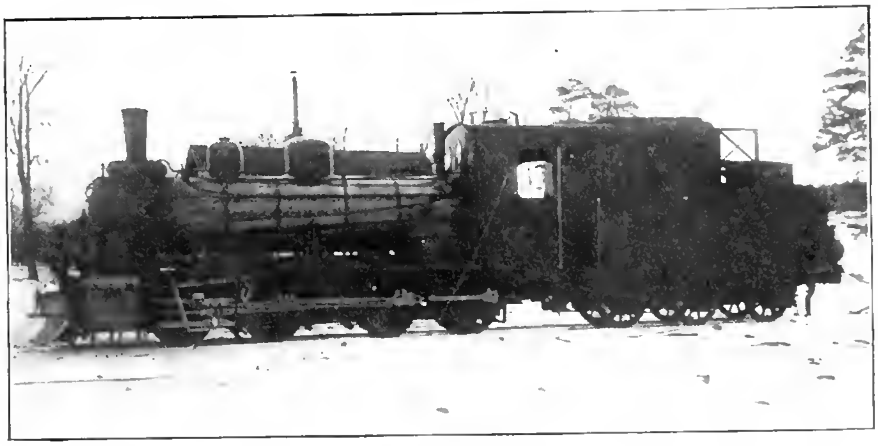
The Chicago Junction has ordered 2 six-wheel switching locomotives from the American Locomotive Company. They will have 20 by 26 in. cylinders, 51 in. driving wheels and a total weight in working order of 149,000 lbs.

The Baltimore & Ohio has contracted with the Union Switch & Signal Company for the installation of an electric interlocking plant for the Calumet river drawbridge near Chicago. The machine will have a 29-lever frame, 18 working levers, 4 spare levers and 7 spare spaces.

Swedish Peat Powder Burning Engine

The use of peat as fuel in locomotive engines has been repeatedly experimented with, and the reports were generally more of less favorable to the use of peat as a substitute for coal in certain localities, but no sustained attempts, as far as we are aware, have been made to put the proposition into actual practice until quite recently the Swedish State railways are evidently giving the matter serious attention, and we would not be surprised to learn that in the near future the use of peat, or a large admixture of peat, becomes the staple fuel in localities where peat is readily procurable.

Owing to the fact that Sweden has enormous peat deposits, many attempts have been made during the last few years to invent and develop devices for utilizing these deposits. Many experiments have been made in stoking stationary engines and the results have apparently been satisfactory. Quite recently experiments have been made in stoking railway engines and it is claimed that these efforts have also been crowned with success.



SWEDISH STATE PEAT POWDER BURNING LOCOMOTIVE.

The heating power of Swedish peat is such that 1.8 tons of clod peat are equivalent to 1 ton of English steam coal. A young Swedish engineer has been conducting the experiments with railway engines under official control. With a device invented by himself, he has made trial stokings with pulverized peat on one of the State railway engines with coal and peat simultaneously, and has even made 1.3 tons of peat do the work of 1 ton of coal. The fuel economy achieved in these experiments is explained by the fact that less air is necessary in the combustion of pulverized peat than in stoking with clod peat.

As a result of these tests peat-powder stoking has been introduced on the Halmstad-Nassjo Railroad and the Kalmar Railroad, besides which the Swedish State railways have procured a trial railway engine for peat-powder stoking. The Finnish Government railways are now constructing four railway engines to be stoked in this manner.

Frederic A. Delano.

When Mr. Frederic A. Delano, president of the Chicago, Indianapolis & Louisville Railway accepted from the President of the United States the nomination as a member of the Federal Reserve Board, the railway service lost one of its most able and eminent officials. Mr. Delano was a college graduate before he entered railroad service, which he did at the bottom of the ladder as machinist apprentice in the Chicago, Burlington & Quincy Railroad shops at Aurora, Ill. That was in 1885 when he was twenty-two years of age. Whatever Mr. Delano was engaged doing he seemed ever determined to put his most vigorous energies into the work, practice which commended him right along to more responsible positions.

From the machine shop he went to the tests department, then became assistant to vice-president. He had not held that job long when a clear headed man was wanted for superintendent of terminals and Mr. Delano was selected. Next we find him superintendent of motive power, from which he went to be general manager. Then we find him consulting engineer to the U. S. War Department and Philippine Commissioner.

His conspicuous ability commended Mr. Delano for such a position as president of the Pennsylvania Railroad or some other Trunk line, but while waiting to get there he accepted the position of president of the Chicago, Indianapolis & Louisville Railway. With all his success Mr. Delano is always a genial gentleman holding the good will of high and low. He is a high official that the railway world hates to see going into another field, as he has acquitted himself so ably in many positions on railroads.

Books, Bulletins, Catalogues, Etc.

Air-Brake Catechism.

The twenty-sixth edition of the Up-to-Date Air Brake Catechism, by Robert H. Blackall, extending to 411 pages, has just been published by The Norman W. Henley Publishing Company, 132 Nassau street, New York, and contains all the original features that have maintained the popularity of the work and also much new matter, calculated to meet the changed conditions of service which prevail at the present time. The work is one of the very few engineering books that may properly be said to have a distinct place of its own as a standard work on a subject of great and growing importance. Its outstanding merit has been, and continues to be, its completeness of detail and exactness in the presentation of facts. There are no idle generalizations or evasive guess work about the book. It is simple and direct and reliable. There are over 2,500 questions with their answers attached, and with the help of the numerous illustrations any earnest student of ordinary mental calibre may master the intricacies of the modern air brake with all its convolutions. We do not know of any other book that so completely does this. The price is Two Dollars.

Traffic Glossary.

The La Salle Extension University, Chicago, has issued a Traffic Glossary, which has been compiled and edited by Prof. R. E. Riley. The need of such a publication is evident when we consider the fact that there are many terms of a very technical nature used in daily traffic work. These terms are of two classes, one class referring to traffic territories and the other to terms having a special meaning such as "basing points." It would be idle to assume that such terms could be summarily comprehended in a poster or stored in the memory. These have their limitations. As an illustration we might ask, how many railway men could tell off-hand what advance charges, relief claim, concurrence, dunnage, pro-number, and long-and-short-haul clause all mean? Or if these seem too easy, what do the following abbreviations refer to—K. D., L. C. L., N. O. I. B. N., N. O. S., O. R. S. U., W. B.? The book explains all matters of this kind, and all other traffic terms and markings. The price is one dollar.

Proceedings of the Sixth Annual Convention of the International Railway Fuel Association.

The proceedings of the above association, the annual convention of which was held at Chicago on May 18-21, 1914, are now published in book form, which extends to 344 pages. The growing importance of the work of the association is ably reflected in the publication. The papers presented and the discussions thereupon all tend towards conserving the world's fuel supply and the advantages that would accrue therefrom. The observations of those whose experience has made them recognized experts in their particular lines of work need just such a vehicle as the work before us to convey to others information of value especially looking toward the elimination of waste in fuel, and not only so, but to inculcate the best practices in the use of fuel; in other words, to learn what coal is and how to use it. The association is thus doing a good work in obtaining a knowledge of the materials that are doing the world's work, and through that knowledge correcting the methods of using the materials. The book contains a list of the membership which embraces many of the leading railroad men in America. Application for copies should be sent to Mr. C. G. Hall, Chicago & East Indiana Railroad, Chicago, Ill.

Malleable Castings.

The National Malleable Castings Company's circular No. 52 is a finely-illustrated publication relating to malleable iron washers and bridge pin nuts. Experience has shown that washers made of refined malleable iron are practically indestructible and not subject to breakage as are cast-iron washers. Not only so, but the surfaces have the cleanness of tool-finished metal. Their lightness also is a decided advantage. The same may be said of the various kinds of socket washers and angle washers which can be readily furnished in any desired design or size. The ribbed pattern of malleable iron spool washers are also meeting with popular favor and can be procured in all sizes. The neat appearance of the various sizes of bridge pin nuts, also of malleable iron, is a marked feature of their superiority to cast-iron nuts. Copies of the circular may be had from the Cleveland office of the company.

"National" Bulletins.

The National Tube Company, Pittsburgh, Pa., is adding to its reputation not only by the variety and number of mechanical appliances than are being added to the sum of its products, but also by the high-class bulletins that are being issued by the enterprising company in describing them. Among the more recent publications of this kind, No. 13A describes with completeness of detail the National Tube Company iron body brass-mounted wedge gate valves. These valves have stood the test of time and have many merits peculiarly their own. Among

these the valve seats are unique, being tapered and faced with brass rings, of a composition especially adapted to the purpose, which are firmly screwed into place by machinery and finally carefully finished. Each side of the wedge disc is faced, with a brass ring, of the same composition as the seat ring, which is rolled tightly into a dovetailed groove. These valve seats never wear. Another very interesting bulletin is No. 10C, which treats of "The relative corrosion of iron and steel pipe as found in service." All interested in pipe should secure a copy of this document, which is from the scholarly pen of Professor William H. Walker, Ph.D. Copies of these publications may be had on application to the company's office at Pittsburgh, Pa.

Reactions.

The latest issue of *Reactions*, a quarterly periodical devoted to the science of Aluminothermics, contains much interesting matter finely illustrated, showing a variety of welds by the Thermit process, and all tending to show the high degree of perfection to which the Goldschmidt Thermit Company's products have reached in the process of welding. About ten pages are devoted to subjects selected from around the railroad shops. These embrace frame welding, driving wheels, crossheads, cylinders, truck frames and other portions of locomotives, and all described and illustrated with a degree of clearness that could not be surpassed. These remarkable welds are not the work of the company's experts, the operations being entirely conducted by the employees in the various railroad shops where the welding appliances are in service. Send for a copy of the latest issue of *Reactions* to the company's main office, 90 West street, New York.

The I. C. S. at Home.

A very interesting and finely-illustrated circular showing what the International Correspondence Schools mean to the city of Scranton has been published and it is a revelation of the magnitude to which the great educational institutions have gone. Quotations from the Scranton newspapers are eloquent in the praise of the amazing accomplishment in the work of providing and conveying education to countless thousands on almost every subject. It is a real universal university. In this colossal work over 5,000 people are employed. Over 100,000 new students enroll in its courses each year. The universities of Oxford, Cambridge, Harvard, Yale and Princeton look small beside this noble institution. Those ancient cloisters of learning may be said to be in the interest of the privileged class, but the Scranton Institution is open to all who out of their necessities may be able to pay the moderate price of text books and fees, and continue at the work in which they may be engaged, while preparing for higher and better things. What the I. C. S. has done for Scranton may be measured. What it has done for the enlightenment of intelligent humanity is immeasurable.

United States Light and Heating Company.

Mr. A. H. Ackerman, vice-president and general manager of the above company, has issued the following statement to the trade and to the public: "The action recently sustained in the appointment of the receivers for the property of the company was a necessary step to conserve the assets for the benefit of all. With assets of $3 for every dollar of debt, the company is amply stable, and the court's direction to continue the business is the last proof necessary to reassure the buying public. There are already under way plans for broad financing, and with the return of general prosperity in the country, the USL, more aggressive than ever before, intends to secure its own full share of the business and to continue the manufacture and sale of its special electrical products."

Forcible Remarks.

An old gentleman joining the Scotch express at Euston, London, one night informed the conductor he was traveling to Crewe, and wished to sleep all the way up. He stated that whenever he was awakened out of a sleep he refused to obey anyone, and always gave way to very strong language. "However," he said, "no matter what I say or do put me out at Crewe." This the conductor consented to do, and the old man fell into a peaceful slumber. After a good snooze he awoke and discovered the train was at a standstill—at Glasgow. The Scotch conductor was standing at the door of his van, and the passenger approached him with flaming face. He made several forcible remarks, and asked him why he did not put him out at Crewe. The conductor listened in silence, and looked at the old man for a while. Then, gripping his beard with his right hand, he said, "Mon, you've a powerful vocabulary richt enough, but you cudna haud a caundle to the man we put oot at Crewe."

High Courage.

I have no fear; and so 'tis day by day,
  In sunshine, or in storm—in weal, or woe—
As best I can, I go along Life's way
  To that Vast Future, where all men must go.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, October, 1914. No. 10

New Bascule-Bridge on the Canadian Pacific Railway

The completion of the new Bascule-Bridge from Sault Ste. Marie, Ontario, Canada, to Sault Ste. Marie, Michigan, on the Canadian Pacific Railway marks a new record in bridge construction, as the its opening last month was really ahead of the time when it was expected to be ready for the operation of the railway joining the United States with the Canadian Dominion at this important point The accompanying illustrations will give some idea of the vast magnitude, as well as the intricate details of the colossal structure. The first view is taken from the operating tower, and shows the south

NEW BASCULE-BRIDGE BETWEEN SAULT STE. MARIE, MICHIGAN, AND SAULT STE. MARIE, ONTARIO, ON THE CANADIAN PACIFIC RAILWAY.

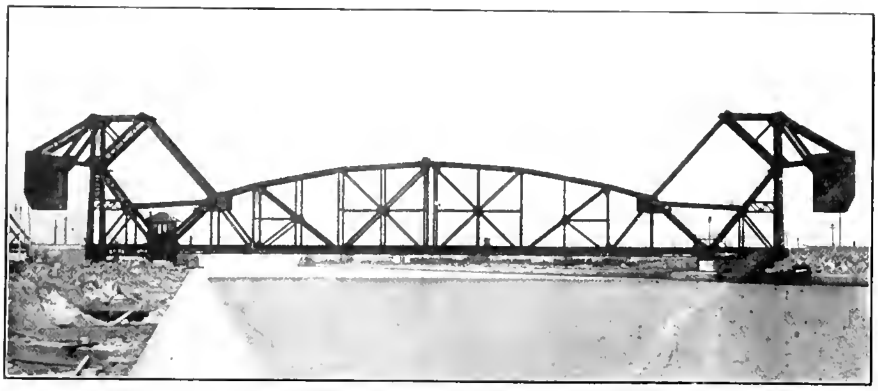
structure is the largest of its kind in the world, being 330 feet in length, and containing several features peculiarly its own. The rapidity with which the work has been constructed has been such that The design of the bridge chosen was that submitted by the Strauss Bascule-Bridge Company, of Chicago, Ill., and the work has been carried out by the Pennsylvania Steel Company, of Steelton, Pa. leaf of the bridge closed with the north leaf in the open position. Each leaf is hinged on a steel tower, and is exactly counterbalanced on the opposite side of the tower. On the balancing structure

there is a concrete block containing five hundred and fifty cubic yards of concrete, and weighing over one thousand tons. So exactly is each leaf of the bridge balanced with the outer counterweights that a very light power is necessary to be applied to raise the leaf and lower the counterweight, the one acting in equilibrium with the other.

The second view shows a general view of the bridge with both leaves centrally locked in place. It should be mentioned in this connection that the south leaf arch tower rests on rollers, allowing a six-inch transverse or side-swing movement to the entire southern leaf in either direction. The operation of this movement when it may be necessary is accomplished by hydraulic cylinders, and a suitable hydraulic hand pump is arranged so that the operator can force the liquid under pressure on either side of the plunger, and so eventually move the entire tower and attached leaf in either direction, so that the two leaves speedily and exactly join in their necessary and perfect alignment.

The last illustration shows the bridge with the two leaves fully opened, and it may be added that while both leaves are opened to vessels of larger dimensions having deep draught, which consequently makes it necessary for them to keep in the center of the channel, vessels of lesser draught may safely pass through with one leaf open, but the opening or closing of both leaves of the great bridge is so easily accomplished, as we have already stated, that the expense of the movement is almost a negligible quantity, and only involves the light handling of an ordinary hydraulic jack, and it may also be safely stated that as the balancing is so perfect, and the moving parts so massively and simply constructed, that the possibility of any part of the structure to get out of order is reduced to a minimum.

The Canadian Pacific Railway is to be congratulated on the completion of the work, and we understand that others of this particular kind of structure are contemplated. It is not likely, however, that the others will be as large as the structure just finished. The tests have demonstrated the absolute rigidity and complete safety of the structure under weight many times more than will ever be placed upon it in actual service. While no expense has been spared in securing the best materials available, and the best workmanship under thorough inspectors, the manipulation of the vast structure is, as we have stated, exceedingly simple, and one tower man is all that is necessary in handling the few mechanical appliances used in raising and lowering the leaves of the bridge.



NEW BASCULE-BRIDGE WITH LEAVES CENTRALLY LOCATED IN PLACE, CANADIAN PACIFIC RAILWAY.

NEW BASCULE-BRIDGE, CANADIAN PACIFIC RAILWAY, WITH LEAVES FULLY OPENED.

As is well known, the Canadian Pacific Railway is the largest in the world, extending as it does across the American continent at its widest part, and with its numerous branches has a roadway of over 12,000 miles. The equipment, especially in the mechanical department, is of the finest, while the very small number of accidents is the best proof of the able management, and has been a distinguishing feature of the history of the railway since the main line was opened in 1887. The numerous branches and leased lines were acquired at different periods. The company also runs a line of mail steamers between Vancouver and China and Japan, and also has lines of steamers running to Australia, to Hawaii, to San Francisco, to the mining district of southern British Columbia, to the Yukon, and from Fort William to Omar Sound on the upper lakes, and also maintains a steamship service between Montreal and Liverpool.

Valuation of the Great Northern Railway.

Eight government engineering crews have started work on the valuation of the Great Northern properties. This marks the first step in the Northwest toward the completion of the stupendous task of valuation undertaken by the Interstate Commerce Commission. Officials of the Great Northern estimate that the appraisal will cost the road between $150,000 and $200,000 a year. The crews are in the territory west of Minnesota and are being directed from Kansas City and San Francisco. Crews will be started on the lines in Minnesota late this fall or early next year, although the commission has not notified the road to prepare for them. Engineers employed by the road precede government engineers and prepare material and locate bench marks and old lines for them.

British Railways.

Government returns show that during 1913 the railways of the United Kingdom carried 1,228,316,000 passengers and 371,571,000 tons of freight. The passengers were divided into classes as follows: First, 26,025,000; second, 12,088,-000; third, 933,498,000, and workmen, 256,705,000. The number of season-ticket holders is estimated to have been about 595,000.

The length of the lines reduced to single track was 55,438 miles. The gross receipts of the companies were $677,674,-724, of which $277,044,978 was derived from passenger traffic, $324,191,630 from freight traffic, and $76,438,115 from other sources, mainly subsidiary businesses. The gross expenditure was $424,563,193, of which $383,494,799 was devoted to operating expenses, leaving a net income of $253,111,531.

Railway Supplies for Chile.

The Chilean Government has had under contemplation for some time the installation of oil-burning equipment on all the government railways of that country. Before doing so, however, it has decided to turn over one entire division of the Longitudinal Railway, which consists of about 125 miles, for exhaustive experiments. It has, we are informed, asked for no bids on this experimental work, the proposition having been worked up by individuals from the United States.

As there is every reason to believe that the result of these experiments will result in the installation of oil-burning equipment on the entire system of government railways, it might be well for American manufacturers of this class of railroad material to get in touch with the officials having charge of this work, as it will undoubtedly be quite an extensive field for the sale of this class of material.

The Chilean Government has authorized an expenditure of the equivalent of $60,000 American gold for machinery and supplies to be installed in the government railway shops. Interested parties would do well to communicate with Direccion General de los Ferrocarriles, Santiago, Chile.

Railways in Honduras.

Honduras is perhaps the least known of all Central American countries, mainly because of the lack of transportation facilities. A number of railroads are in process of construction on the north coast. Most of them are primarily for the development of the banana industry, and that of Vacarro Bros. & Co., with 75 miles in operation, and the Honduras National Railroad, with 55 miles in actual operation, are the only roads that carry passengers. It is of interest to note, however, that besides investing nearly $100,000 in necessary locomotives, rolling stock, rails and betterments, the government reports a net profit of $44,425 in the first 18 months of the government management of the National road. It has about completed the bridge over the Ulua river to connect up some 7 miles of road long disused. This will put the road in operation to Protrerillos, and permit the extension of the line farther south if desired.

Canadian Northern Railway.

A Vancouver press despatch credits Sir Donald Mann, vice-president of the Canadian Northern Railway, with saying there: "Despite the chaotic conditions of the money markets, due to the war situation, we intend to finish up the transcontinental line as quickly as possible."

Sir Donald, who went on to Victoria to confer with the Premier, Sir Richard McBride, is also reported to have said that the company has 3,000 men employed in British Columbia, and will keep them at work until rail laying is finished. Grading, he believes, will be finished by the end of September. Steel has been delivered or is en route for all sections of the main line west of Yellowhead Pass, and the line north of Lake Superior will be in operation this autumn.

The Longest Tunnel in America.

The longest tunnel in North America is the Hoosac tunnel, at North Adams, Mass., which is four and three-quarters miles in length; but there is now being constructed on the Rocky Mountain Division of the Canadian Pacific Railroad, what is known as the Roger Pass Tunnel, which will be five miles in length. It will cost over $10,000,000. The highest point reached by the tunnel will be 3,795 feet above sea level, or 4,065 feet below the extreme top of the mountain. The tunnel will have a rising grade of one per cent. to its interior summit.

Automatic Signalling on the Pennsylvania.

During the past three years the Pennsylvania Railroad has equipped 253 miles of its main lines with automatic signals at a cost of $6,000,000, and has now more 4-line road so signalled than any other railway in the world. This signalling is officially stated to represent an outlay of about $18,000,000. Normally some 1,800 men are employed to maintain this signalling, and the maintenance cost is $1,500,000 per annum.

Railways in Peru.

Very little progress has been made in the construction of railways in Peru, owing principally to the mountainous nature of the country, which makes it both difficult and costly. The only addition in recent years has been the Lima to Huacho Railway. There are in course of construction a line from Cuzco to Santa Ana, and another from Lima to the small port of Chilca. No work has as yet been begun on the projected railway to navigable waters of the River Ucayali.

Erie's Triplex Compound.

Another record has been made by the Erie's giant engine, Mat Shea, in hauling 250 50-ton steel gondolas loaded to capacity from Binghamton, N. Y., to Susquehanna, Pa., 23 miles at a maximum speed of 14 miles per hour. The total length of the train was 1.6 miles. The maximum drawbar pull was 130,000 pounds, and the minimum 67,000 pounds. The locomotive is named after one of the oldest and most accomplished engineers on the Erie Railroad.

Alaska Railways Surveys.

Good progress is being made with the surveys for the Government railway in Alaska, and it is possible that a preliminary report on the undertaking will be ready for submission to President Wilson late in October or early in November. At the present time parties are working south from the Tanana river, while engineers are working north. Work is also in progress at Portage Bay and Seward, and along the line to the head of Cooks' Inlet. The surveys are being made for a route from the coast through the Susnita Valley to the Tanana. This, in general, follows the line of the Alaska Northern Railway to Grand View, 45 miles from Seward, the coast terminal of the railway. Cross-sectioning was started two or three weeks ago on the new route surveyed from Grand View to Turnagan Arm. The coast terminals under consideration at present are Seward and Portage Bay.

Brazilian Railway Extension.

The railway mileage in Brazil during 1913 was increased 1,438, making a total of 15,246 miles in operation, of which 2,185 miles are Government lines, 5,716 miles privately leased roads, 3,447 miles granted to various enterprises by Government concessions, and 3,897 miles operated by private corporations under state concessions.

The Estrada de Ferro Coste de Minas, a Federal Government road, increased its mileage by 805. During 1913 this road carried 336,276 passengers, 69,264 animals, 6,314 tons of express packages, and 139,448 tons of freight.

A No Profit Railroad Scheme.

We understand that a peculiar enterprise in railway construction and operation is under way in Alabama. We learn that the town of Fairhope, a single tax community, has raised sufficient funds to build and put in operation a railroad without the issue of bonds or stock of any kind. The necessary money has been raised by a bond issue of 6 per cent., with the addition of certain fees paid by the members of the corporation, who shows no returns, but have a share in the management of the road. Profits must go to the construction of extensions or the reduction of passenger fares and of freight rates.

We have heard about many railroad building schemes that were to bring joy, comfort and transportation service that was to cost next to nothing, but the Fairhope railroad scheme is the silliest of all the attempts to secure railroad accommodation for nothing. Who is he anyhow? And where does he and his fellow promoters think they come off at?

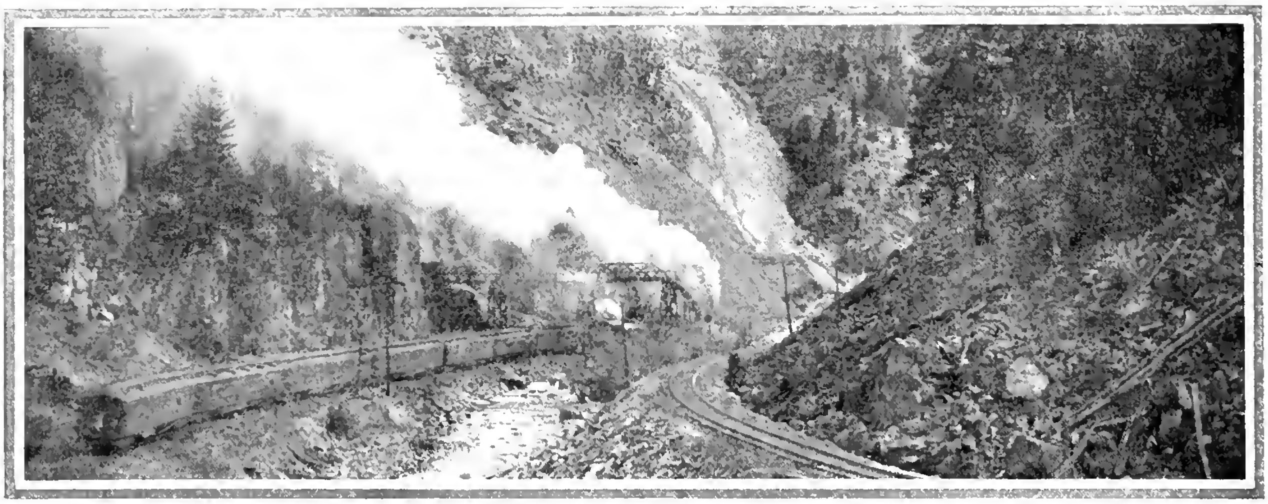
On the Denver & Rio Grande, and Western Pacific

The unusual engineering feats that have been accomplished in the construction of the Denver & Rio Grande Railroad rival the scenic wonders of that region through which the road passes and which at this season of the year particularly attract the attention of all who have an eye to the sublime and picturesque in natural phenomena. Passing through Colorado and Utah, the road and its numerous branches now extend to over 3,000 miles, and there is perhaps no region in the world so prolific of natural wonders or where more engineering skill has been exhibited in overcoming difficulties that would seem at first glance to be insurmountable. We have frequently referred in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING to the Royal Gorge of Colorado, which may be justly called one of the scenic wonders of the world. A cleft in the Rocky Mountains, at some points not more than thirty feet in width, is traversed by the Arkansas River and along the banks of this turbulent torrent a railroad has been constructed. The gorge is eight miles in length. The cleft at some parts is so narrow that the daylight is practically excluded, a faint glimmer here and there giving evidence of the brighter world outside.

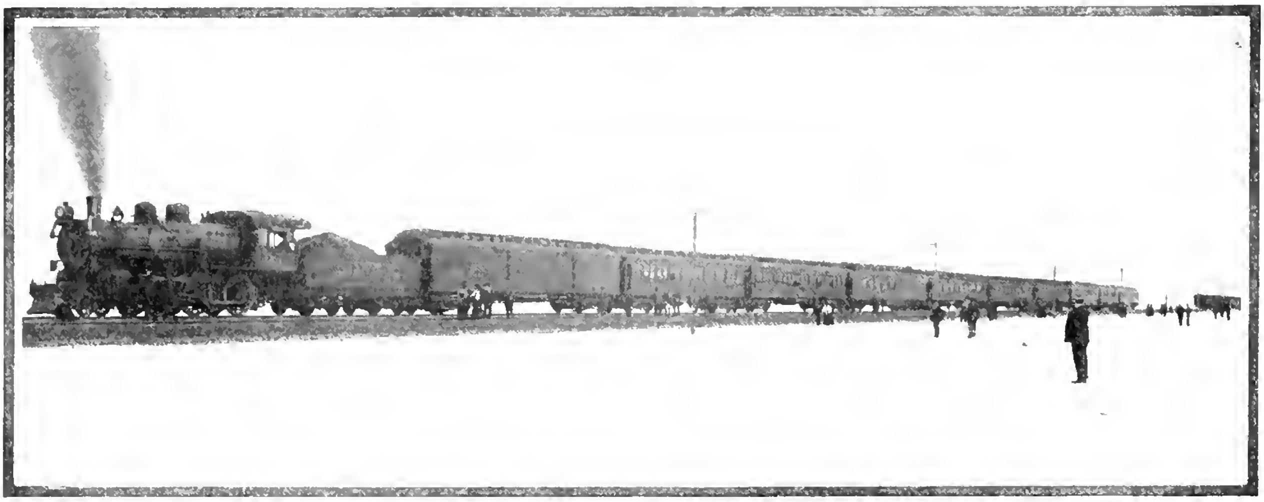
Great as this engineering feat was in constructing a railroad along the gloomy cavern there are other almost similar triumphs of skill in construction that are worthy of particular notice, as well as other rarities peculiar to the locality, and now that the American people may be debarred for a time from rushing in such numbers to the antiquated curiosities of Europe in all likelihood more attention will be given to the newer and grander wonders of the western world.

Among the construction work the first of the accompanying illustrations show a double tracking in the Eagle River Canyon on the main line of the Denver & Rio Grande railroad in Colorado. In this remarkable canyon, which is here and there dotted with the shaft houses and dwellings of the adventurous miners, and the walls of which rise from 2,500 to 3,000 feet above the road bed, the tracks have been built on both sides of the river, and the geological strata is of such a rich variety of coloring that it may be said to rival the rainbow hues of the variegated foliage that make the American forests such a marvel of coloring during the Autumnal season.

The second illustration shows a part of the Western Pacific roadbed which connects with the Denver & Rio Grande at the Great Salt Lake. The railroad at the point shown passes over the great salt beds at Salduro, Utah, 112 miles west of Salt Lake City. The railway crosses these salt beds for over 30 miles. This is one of the most remarkable natural phenomena in the world. The salt beds extend for a distance of 65 miles in one direction and 8 miles in the other, and the salt deposits are from two to fifteen feet thick. A strange feature of the salt deposit in this region is its extreme hardness. In the setting of the telegraph poles along the line, it was found necessary to use dynamite in blasting holes for the poles.



DOUBLE TRACKING, EAGLE RIVER CANON, ON MAIN LINE DENVER & RIO GRANDE RAILROAD.



WESTERN PACIFIC ROADBED ON THE GREAT SALT BEDS AT SALDURO, UTAH, 112 MILES WEST OF SALT LAKE CITY.

The third illustration is also a view on the Western Pacific railway and shows a part of the railway known as Williams Circle, and is located in Feather river canyon, California. The construction of the circle was found to be necessary in order to maintain a maximum grade of not over one per cent. The circle is one mile in circumference, and is one of the most remarkable engineering curiosities on the western slope of the Sierra Nevada.

The combination of these two railways with their main lines and numerous branches, not only reaches many important cities and towns, but penetrates the richest agricultural, horticultural, mining and manufacturing districts of Colorado, Utah and New Mexico and affords ready access to the great markets of the East and West. The Western Pacific railway, which is really the Pacific coast extension of the Denver & Rio Grande, from Salt Lake City to San Francisco, has opened up new lands, new cities and new opportunities in a hitherto untravelled West.

The Denver & Rio Grande lines in Colorado now extend to 1,800 miles and in Utah to about 800 miles. Of these 2,600 miles over 1,800 miles are of the standard 4 ft. 8½ ins., gauge, and the remainder mostly in the mountainous districts of the 3 ft. gauge. There are 616 locomotives and 18,778 cars. The road was chartered in 1886, and since thet period has absorbed a number of smaller roads. The Western Pacific railway extends to 946 miles, standard gauge, and has 115 locomotives and 1,574 cars in operation. The line was placed on an operating basis July 1, 1911, although not then fully completed. This line has also a first-class ferryboat service between San Francisco and Oakland. The Salt Lake City Union Depot, which is jointly owned by both companies, was completed in August, 1910, at a cost of over $1,250,000, is one of the most elegant and substantial railway depots in the West, and it is gratifying to know that in spite of the general depression in business the two important railways are showing a steadily increasing report of both passenger and freight traffic, and when the revival of business comes, as it surely will come before long, the growth of the roads will be one of the marvels of the great and growing West.

WILLIAMS CIRCLE, WESTERN PACIFIC RAILWAY, FEATHER RIVER CANON, CALIFORNIA. ONE MILE IN CIRCUMFERENCE.

Spectacles for Enginemen.

The Board of Railway Commissioners for Canada has just adopted standard rules for testing eyesight, and from this we learn the following as to men wearing spectacles. Applicants for entrance to railway service as enginemen, firemen, trainmen, or brakesmen, shall not be accepted if they have to use glasses for near vision. Applicants for other positions and employees in all branches of the service may use glasses for near vision when undergoing examination. When the distant vision of an employee can be improved by the aid of glasses, he should wear them. All employees who require the aid of glasses for distant vision must wear them at all times when on duty and must carry a duplicate pair for use in emergency and will be examined with each pair. The use of amber glasses by firemen as a guard against temporary fire blindness shall be permitted and should be encouraged. Glasses of all kinds must be approved by an oculist designated by the company. We may add that in testing the eyesight the examiner uses: A set of Snellen's test types, with at least three cards of each size of letters shown in different combinations; an American Railway Association standard reading card for testing near vision; a Holmgren or Thompson color selection test; a William lantern, or one similarly constructed; a pair of spectacles, or shade, for testing each eye separately; a triple-grooved trial frame, with one pair of plus two diopter lenses, one pair of plus one diopter lenses and glass roundels.

British View of American Railroads.

In a recent editorial the London *Times* says:

"The history of American railroads is full of human interest, and will be found fascinating by any one who sympathizes with human effort. The builders seem to have had only one desire: To push further and ever further into the empty continent.

"Building was hurried and flimsy single-track lines just held together under very moderate traffic. American railroads suffer to this day the consequences of that initial insufficiency. Enormous capital has been sunk in the conversion of these insubstantial lines into the solid, heavily metalled railroads that now serve a vast and busy population. Immense further expenditure is called for to provide equipment to deal with the ever increasing business. The money beyond a doubt will be found.

"Nothing comes out more clearly from the information published than the closeness with which the railway system is interwoven with the whole social and political development of the United States. It is not too much to say that it is one of the most potent factors in determining the practical reading of the Constitution itself."

Our Patent Laws.

Our patent laws not only protect the inventor or owner of a patent from infringement, but also give him the right to withhold the subject of his patent from general use, and to make it abroad without giving the United States any return for the monopoly. Patent laws should protect the inventor in a liberal way, but our law goes far beyond those of other countries. It would be fair to permit the manufacture and sale of a patented article which the owner of a patent cannot or will not supply in this country. Doubtless improvements in these laws will come in the near future.

General Correspondence

S. F. Governor.

EDITOR

Replying to the article on page 285 of the August number of your valuable publication, by Mr. J. J. Jones, with reference to the advantages and disadvantages of excess pressure governor top used with the E. T. equipment. In this connection I wish to state that there are practically no disadvantages of using the S. F. type pump governor with the E. T. equipment when the feed valve and governors are in good condition; in fact many roads are using this governor with the G-6 brake valve piped according to the "Schedule U" equipment with good results, and experience practically no trouble at all with this type of governor.

The throttling down of the pumps before the maximum pressure is reached, of which Mr. Jones complains, can be entirely eliminated by keeping the governors and feed valves in good condition, and having feed valves properly cleaned and repaired, and tested to operate by light fluctuations in brake pipe pressure, same not to exceed 2½ pounds.

When a defect in an excess pressure governor is found to exist on line of road, all that is necessary is to cut out the excess pressure governor top by placing a blind gasket in connection to lower part of excess pressure governor top at connection marked A B V, and let maximum governor top control the pump, engineer reporting condition of governor on arrival at shops.

In practically every case where the pumps are throttled down by the governors before the maximum pressure is obtained in main reservoirs it is due to some defect, such as a bad leak in feed valve pipe to excess pressure governor top, or a feed valve pipe to excess pressure governor that is partly obstructed, or a sluggish feed valve, a leaky pin valve 33 in either governor top in combination with a vent port 22 that is stopped up.

Some of the other causes of the S. F. type governor failing to control the pumps properly are a bent pin valve 33, leaky diaphragms obstructed waste port W, pin valve 33, and seat worn badly, part P stopped up in automatic brake valve ports C and D stopped up, leaking pipes, and obstructed pipes leading to governors, piston 6 and packing ring 7 fitting their cylinders too loose. After a governor has been repaired it should be thoroughly tested, and it must be in such a condition that it will operate the pumps with a variation of 2 to 3 pounds in the pressure that operates the governor, that is, by brake pipe leakage or other causes brake pipe pressure drops back 2 pounds. When the feed valve opens and supplies this leak the governor should at once let pumps go to work and replace this 2 pounds which has been taken from main reservoir pressure.

The wearing of the steam valve Mr. Jones speaks of is due mostly to defective repairing of the parts and improper lubrication. In reboring the cylinders care should be taken to see that the cylinder is bored central with the guide. The piston 6 and ring 7 should be a neat fit in their cylinder, and piston spring 9 should be of the right tension.

The advantages of the S F governor are many: positive excess pressure controlled by feed valve adjustment, and 20 pounds additional excess pressure when the automatic brake valve is placed on lap service application or emergency position. When changing from low to high speed brake, the pressure can be regulated by merely screwing up on feed valve, whereas with the S D governor it would be necessary to regulate feed valve and governors. The S F type governor was designed for use with the E T equipment, and no advantages would be obtained by using the S D governor in connection with the E T equipment.

Mr. Jones' idea of the S F governor throttling the pumps down and causing the steam valve in pump governor, and steam valve mechanism in pump, to wear, is, in my opinion, a mistake, as if these parts receive the proper lubrication it makes no difference what type of governor is used.

It is also immaterial as to the length of the train, provided, of course, you have air pumps with capacity to maintain standard brake pipe pressure. Engines handling more than 40 cars should be equipped with two 9½ pumps, or pumps with a capacity that is equal to or more than two 9½ pumps, as a certain amount of brake pipe leakage is bound to exist. J. H. HAHN,

Air Brake Mechanic, Savannah, Ga.

Southern Shops A. C. L. Ry.

British Cars and Corridors.

EDITOR:

Since coming to America a few months ago I have been greatly struck with the many marked improvements in the methods of transportation in America as compared with the British methods. My attention was called to the very interesting article in the August number of RAILWAY AND LOCOMOTIVE ENGINEERING, and also to the criticisms on the article made by a correspondent in the September issue. The article referred to described the cars and corridors on British railways, and while there was much truth in the description, I presume that when the writer stated that the corridors never came together on one side all the way through the train except when the royal family was traveling, he was merely emphasizing a particular defect in the older style of cars. Nearly all of the express trains are made up of the newer kind of cars having central vestibules and ready means of passing from car to car.

At the same time it is senseless to deny that there are still a very large number of the older type of cars, which, when mixed with cars of the newer types, afford no means of communication between the cars. These cars are now mostly used on short runs, and, of course, get sadly mixed. They are mostly relics of the last century, but we will not see the end of them, I mean the last end of them, for many years to come. They are behind the age, and in no way comparable to the ordinary American railway car.

As to the methods of handling baggage the American system is altogether admirable, not because there is much baggage lost or stolen on British railways, but on account of the general inconvenience and annoyance caused to the passengers in looking after their belongings, as they must do unless in the case of such baggage as may be forwarded by the express transportation companies. Britain has surely much to learn from American railway methods.

A. W. DOW,

Late on the North British Railway,

Now of the Central Railroad of New Jersey.

Jersey City, N. J.

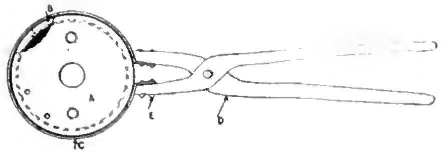
Inserting Rings in Pump Cylinders.

EDITOR:

Referring again to the subject of compressing rings in order that they may conveniently be placed in pump cylinders for which each shop, and in many instances each mechanic, has some scheme of its or his own, I venture to suggest a device of my own which suits the purpose admirably, especially where there is no counterbore in the cylinder.

The accompanying illustration shows my particular plan. A flexible band of steel marked "C" about 1/32 of an inch in thickness, and about one inch wide, is

riveted "E" to the inner side of an ordinary pair of tongs "D." The tongs may readily be opened to allow the steel band to slip over the ring "B" compressing it,



DEVICE FOR INSERTING RINGS IN PUMP CYLINDERS.

so that it will slip into the groove of an air piston "A."

By using the device with one hand the piston can be pushed into the cylinder with the other hand, and the tongs released.

J. A. JESSON,
Louisville & Nashville Ry.
Corbin, Ky.

The Southern Locomotive Valve Gear.

BY HARRY CORNELL, LOUISVILLE, KY.

The accompanying combination diagram of the Southern Locomotive valve gear and piston and crank connection may, with confidence, be used to determine the proportions appropriate to equalized cut-offs in the running positions. With the engine at the front dead center the eccentric is at A on the eccentric circle E, and while the engine is at the back dead center the eccentric is at B. The free end of the eccentric rod occupies the positions A‴ and B‴ respectively for front and back dead center positions of the engine, while the intermediate pivot in the eccentric rod is at F.

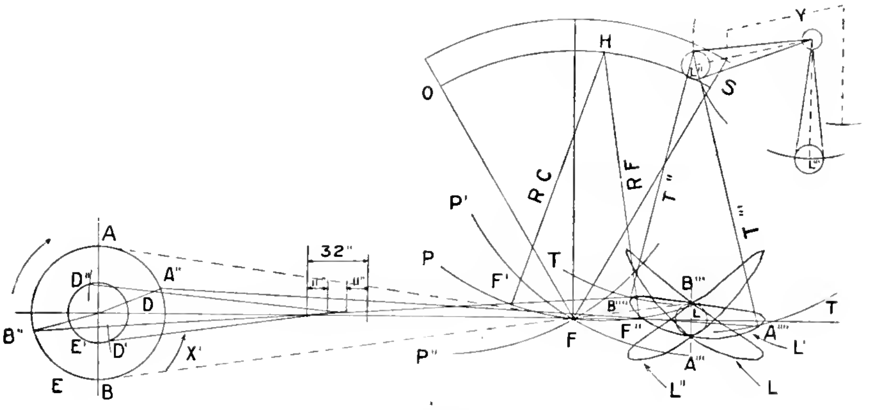
By noting the position A of the eccentric relative to the crank pin D, with engine on the front dead center, we can very readily find the eccentric positions A″ and B″ appropriate to the two 11 inch positions of the piston with the axle revolving in the direction of the arrow X. The eccentric rod is then laid in position A″, F″ and A″″ for cut-off at 11 inches in the head end of the cylinder. The circles L, L″ and L‴ are the lap + lap circles. For cut-off at 11 inches in the back end of the cylinder the eccentric rod must occupy the position B″, F′ and B″″. The radius hanger shown in positions R F and R C respectively for cut-offs at 11 inches in head end, and 11 inches in back end of cylinder, must be of such a length that radiating from the arc O H S, whose radius equals the length of the radius hanger, the radius hanger will sweep through the points F′, F and F″. Having found a length of radius hanger satisfying the conditions previously mentioned we may sweep the arcs P and P′, which enables one to plot the locus L of the free end of the eccentric rod for full travel while engine rotates once in direction of arrow X, and to also plot the locus L′ appropriate to 11 inch cut-offs with the engine moving in the direction indicated by the arrow X. By drawing the arc P″ the locus L″ for full gear working in the direction indicated by the arrow X′. The arcs T and T′ are of a radius equal to the length of the link connecting the valve-operating bell crank Y to the eccentric rod, and is shown in the two cut-off positions, T″ for back end, and T‴ for front end. The foregoing is submitted with the belief that it will be considered timely inasmuch as this excellent valve gear has been applied in large numbers to new engines, as well as to pre-existing engines, with gratifying results.

A Fool-Proof Railway.

BY T. OSBORN, MANCHESTER, ENGLAND.

An Australian inventor who has resided many years in England, has been devoting himself to working out the details of a scheme of railway working, which he claims is foolproof. Having completed his invention he set about actually building a railway on his system on a tolerably large scale; he leased twelve miles of permanent way from the West Somerset Mineral Railway Company, purchased two powerful locomotives form the Great Western Railway, and quietly, but with untiring energy, proceeded to put his ideas into a practical form. The difficulty to be met is briefly: The repeated failures of the human element, resulting in railway accidents, raises the question whether some means of automatically stopping a train when the signals stand at danger cannot be introduced? During a trial run a correspondent states: I rode in the cab of one of the engines over the accident proof system. The prepared railway is entirely devoid of the ordinary signals. At first we ran at the rate of sixty miles an hour over a track devoid of traffic, passing over the sections into which the line is divided. As the engine entered each section a bell with a deep note sounded, denoting that the line was clear. The inventor who was also in the cab said: Now we shall see what happens when another engine is on the line; he rang through from a control box to headquarters, and instructed the driver of the other locomotive to run into a section. It is a single line railway, consequently the second locomotive was on our line directly ahead. The inventor then said: We shall travel straight ahead so as to meet the second engine; now note how the system will work. The driver as instructed pulled his lever and off we started.

The engine rapidly put on speed, ahead on our line; traveling at a corresponding speed was the other locomotive, and there was no apparent reason to prevent the two crashing into each other end on, when all at once at a given point the whistle of our locomotive sounded an alarm, without the driver actuating anything. This alarm would under ordinary working conditions at once inform a locomotive driver that there was danger ahead, but to illustrate the working of the invention, on this occasion the driver was supposed not to have heard it. Before the engine had traveled another hundred yards the brakes began to work, there was an escape of steam, the locomotive slowed down and came to a dead stop. The driver had done nothing, the entire working was mechanical; precisely the same would have happened if there had been no driver. The principle underlying the invention may be quoted in the inventor's own words: A brief examination of the permanent way and the control boxes will make the working clear. Every section of the line is guarded at both ends by three ramps, that is, metal appliances between the rails, which are connected by ordinary telegraph wires to an instrument in each control box, placed at suitable distances apart. Conversely each locomotive is provided with an electrical contrivance, which is brought into contact with these ramps by an arm extending below the frame of the engine. It follows that with a proper distribution of controls, if two trains were running on the same line, both in



SOUTHERN LOCOMOTIVE VALVE GEAR PROPORTIONED FOR EQUAL CUT-OFFS AT 11 INCHES.

the same direction, if leading train stopped for any reason whatever, the following train could not run into it. A disastrous collision occurred within the last two years in England through the first train locomotive not having enough steam to ascend a heavy and long gradient during the night; another train followed with an interval of say two miles, the driver failed to see the stationary train ahead, with most disastrous results. On single line railways, of which there are a great many in different parts of the world, the system would be of obvious use. Many accidents due to personal carelessness or forgetfulness are on record, one in France not very long ago, which could not have occurred with a system, such as the one briefly outlined. The intention is that as soon as the driver hears the whistle he must himself stop the train; if he fails to do so it is automatically stopped. When steam has automatically been shut off and the brakes applied from the control boxes, the driver is powerless to move the engine, until it is freed by some responsible person at a given point. Briefly, to sum up, the invention completely eliminates the personal element. Should the driver not attend to his duties the train stops, should the occasion arise; should the official at the control fail in any way the system works in spite of him, and lastly, should the system break down, all the trains would be locked.

The system on the model railway in England has been tested many thousand times; under a great variety of conditions it establishes direct communication between a train and the control box, and automatically without the intervention of any human agency provides for the control of the trains whenever two trains are in the same section. Critical experts have asked the following questions: (1) Can the invention be applied on a scale large enough to cover the innumerable complications of an ordinary railway system? (2) How great is the liability to error? (3) What is the cost of installation? (4) Have railway engineers made any adverse comments after examining the model system? The inventor's reply is: As regards questions 1 and 4 the invention is worked strictly on mathematical lines, and that for years all problems incidental to railway traffic have been considered and studied; moreover, during that period a considerable number of railway engineers have discussed the problems with me. The inventor asserts that as a result of study every form of railway operation now required to be carried out on any class of railway tracks, can be carried out by means of the invention, in which the risk due to the man or the machine will be eliminated, while the cost of installation and maintenance will be comparatively small. As regards No. 2 question the devices used are well-known devices adapted to the special needs of the invention, whose operation and working have been recorded for many years, and as they have been in wide use in most countries of the world, answer the question as to their practicability and reliability for general public use. As regard question No. 3 cost, to answer that question definitely one must have plans of the proposed installation as railways differ in class: (a) Single tracks; (b) double tracks; (c) sidings; (d) junctions; (e) termini. The most difficult problem is in the equipping of single railway tracks, on which trains may run in either direction. The actual cost of equipping single tracks, assuming the sections to average four miles each, should not exceed $150 per mile. The cost would vary more or less according to which type of appliance is used. The cost of equipping each locomotive should not exceed $120. In the case of tracks equipped for trains to run in one direction only the cost should be considerably less.

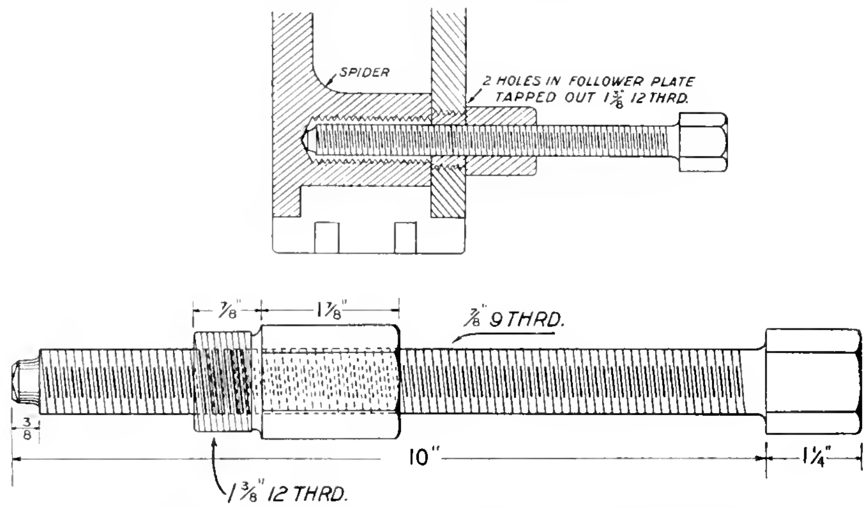
Follower Plate Puller.

By Charles Markel,

Shop Foreman, Chicago & North Western Railway, Clinton, Iowa.

Attached is a drawing showing a follower plate puller, which will be quickly appreciated by engine house foremen and employees generally who have to remove piston followers that are generally in a condition that seems almost solid to the bull ring, by reason of the adhesive character of the carbon which is formed by the action of superheated steam on the oil. It will be noted that only two of the follower bolt holes are tapped out 1⅜ in., with a 12 thread to receive the threaded piece of machine steel, which piece is tapped out ⅞ in. with a 9 thread, and when power is applied to the screw which bottoms on the follower bolt hole something must move and the follower is forced away from the bull ring or spider.

It is not now known here who originated the idea of this effective puller. All we know is that it does the work very quickly and effectively.



2 OPPOSITE HOLES IN FOLLOWER PLATE TAPPED 1⅜" 12 THRD.

DETAILS OF DEVICE FOR FOLLOWER PLATE PULLER.

Metal Polishes.

Among the many varieties of means of polishing metals the following are among the best: Liquid: (1) Thoroughly mix together 3 oz. of prepared whiting, an equal amount of paraffin, 4½ oz. clear oil, and ¾ oz. of oleic acid; if so desired, a little oil of mirbane may be added to perfume it. (2) Mix 4 oz. of prepared chalk, 1 oz. turpentine, ¼ oz. strong ammonia, ¼ oz. of spirit of camphor, together, and rub the metal with it; polish with a soft flannel when nearly dry. (3) Take 1 oz. of oleic acid, 1 oz. turpentine and 2 oz. of benzene. Take some of the liquid, and rub up 2 oz. of tripoli with it, then add the rest and shake well. This will make a very good liquid for cleaning brass work. Apply the liquid with a sponge, and be sure that it is dry before polishing. For crevices use a small plate-brush. (4) In half a pint of hot water dissolve 2 oz. of oxalic acid, and let it cool. Take 8 oz. of finely-powdered rotten-stone, 1 oz. of dextrine, also powdered finely, and 4 oz. of sweet oil or palm oil, and mix into a paste; into this stir the oxalic-acid solution. If this should be too thick to form a liquid, more water can be added. Use a piece of flannel or wash-leather to rub it dry.

Control Equipment.

The Westinghouse Electric & Manufacturing Company has received from the Third Avenue Railway Company a repeat order covering twenty-five PK control equipments for use on their low floor 34 inch wheel car.

Elements of Physical Science

By JAMES KENNEDY

XXV. HYDRAULICS.

Hydraulics treats of liquids in motion. It shows how water is used as a moving power, and also describes the various machines used for raising liquids. It will be readily observed that the velocity of a stream of water flowing through an orifice depends on the distance of the opening below the surface of the liquids. This velocity is equal to that which is acquired by a body falling the same distance.

For example, in a reservoir full of water three orifices made at the depths of 16, 64 and 144 feet, the liquid would issue from them with velocities of 32, 64 and 96 feet per second, such as would be the velocity of a body falling through the different distances named. These figures apply only so long as the liquid is at the same height in the vessel. If the vessel is not replenished, the pressure diminishes as the liquid gets lower. It takes twice as long to empty an unreplenished vessel through a given orifice, as it would for the same quantity of water to escape if the liquid were kept at its original level.

The ancient Romans measured time by the flow of water through an orifice. The instrument was called the clepsydra, or water clock. It was usually made of transparent substances with a hole in the bottom that would allow the water to run out in a certain time. A scale of lines marked on the side of the vessel at different levels, indicated the periods or hours of the day. The divisions were necessarily largest at the top of the scale. Although this instrument served for general purposes it was not correct, as water varied in rapidity according to the temperature and density of the atmosphere.

It may be noted that different liquids escape through openings at different velocities. Mercury flows faster than water, while alcohol has a slower motion than water. The volume flowing through an orifice may also be increased by heating the liquid. Heat lessens the cohesion, and enables liquids to flow more rapidly. It may be added that the friction of water against the sides of pipes has a considerable retarding effect on the velocity of the current, so that an allowance amounting to 50 per cent., is usually added to pipes in excess to what would be sufficient if the element of friction was left out. It will be observed that the velocity of streams is always considerably less near the banks. The windings of streams also retard their velocity. In a straight course a fall of three inches to a mile will give a river a velocity of about three miles an hour. A fall of three feet in a mile will give the impetuosity of a torrent.

The tide, as is well known, is caused by the attraction of the sun and moon acting on the water on the earth, as water being a movable body it yields to the force of attraction. The effect of the sun and moon on the tides is readily seen when these bodies act on the same line which happens at every new and full moon, the tides are highest, and are called Spring tides. When sun and moon act at right angles, the tides are lowest, and are called Neap tides.

XXVI.—WATER WHEELS.

Running water is very useful as a moving power, causing wheels to revolve by its momentum, and so setting machinery of various kinds in motion. There are four kinds of water wheels, the undershot, where the lowest floatboard of the wheel is immersed in water, and the current striking against several of the lower boards carried the wheel around. The overshot wheel is furnished with a number of buckets on its rim. A stream is made to fall on the wheel from above. The weight of the water and also the force with which it falls causes the wheel to revolve. As the wheel turns the buckets empty themselves. Much power is saved by this form of water wheel. The breast wheel is also furnished with apartments on the rim, and the water strikes the wheel about the center. This species of wheel ranks between the overshot and undershot in efficiency. The turbine, instead of being set vertically, is horizontal. To the centre of the wheel an upright pipe is fixed through which the water descends. To the inner rim of the wheel is fitted a fixed cylinder divided into apartments, the wheel itself being divided into similar apartments, but running in the opposite direction. The fixed cylinder is connected with the base of the upright tube. The water from the pipe filling the apartments in the fixed cylinder is charged into the corresponding apartments of the wheel which moves and allows the water to escape after having spent its force in moving the wheel. Where a great height can be secured a small body of water will produce an enormous force by using this form of wheel.

In recent years the use of this form of wheel in driving dynamos has been very successfully introduced in the vicinity of Niagara Falls.

Note: The present issue concludes the series of articles on the subject of the "Elements of Physical Science," which have been running for nine consecutive months, and which have been extensively copied by the engineering press.

Welding Malleable Castings.

While the process of autogenous welding is being used so successfully in all the metal trades, many unsuccessful attempts have been made to weld malleable cast iron, and to those who have experienced disappointment, an explanation that recently appeared in the *Iron Age* of why their efforts failed, with an outline of a method by which these castings can be mended, should be of benefit.

Malleable castings are originally in the condition of hard, brittle, white cast iron, that is subsequently made malleable by heat treatment, which effects a chemical change in the structure by decarbonization. This decarbonization is nearly complete at the surface, but in a lessening degree toward the center, giving the outside portion the texture of mild steel while the inner portion may retain the qualities of cast iron. It is useless, therefore, to follow the welding method prescribed for either material.

To mend successfully a malleable casting the welding material should fuse at a lower temperature than the casting, and its adherence, bonding qualities, physical strength and ductility should closely resemble the original casting.

In preparing the work, the fracture is chipped away in the form of a V-groove, and the part surrounding the fracture is then heated with an oxy-acetylene torch to a bright red, and sprinkled with a bronze flux, followed by a few drops of Tobin bronze melted from the welding rod. If the bronze remains in a little globule the work is not hot enough; but if it spreads and adheres to the surface, the temperature is right, and the groove should be quickly filled, and at as low a temperature as possible. The behaviour of the bronze affords a guide in regulating the temperature. This process cannot be called autogenous welding, but a malleable casting mended in this way is practically as good as one piece. It has about the same tensile strength and ductility as the original, and the process has the advantage of being very quickly performed.

Japanning Springs.

In japanning springs the best practice is to put them into metal baskets, dip the entire basket into the japan, withdraw and drain, and then bake the springs just as they lie in the basket. This will give a uniform coating of japan, which has the merit of resisting atmospheric action for a lengthened period of time.

Twenty-Second Annual Convention of the International Railroad Blacksmiths' Association

The twenty-second annual convention of the International Railroad Master Blacksmiths' Association was held in the last week in August at the Hotel Wisconsin, Milwaukee, Wis., President H. E. Gamble, presiding. Interesting addresses were made by the president and by Mr. A. E. Manchester, Mr. J. J. Hennessey and Mr. J. F. Devoy.

The papers presented and the discussions arising therefrom were all of a high order of merit. Mr. H. G. Sharpley, of the Lima Locomotive Corporation, spoke ably on the subject of "Tools and Formers." Mr. J. W. MacDonald, of the Pennsylvania Railroad, contributed much valuable information on the same subject, and also presented a number of illustrations of dies. Mr. H. H. Hoeffle, of the Louisville & Nashville; Mr. F. B. Nielsen, Oregon Short Line, and Mr. John Carruthers, of the Duluth, Missabe & Northern, spoke on the subject of "Spring Making and Repairing." Mr. George Hutton, of the New York Central & Hudson River; Mr. C. E. Lewis, of the Pennsylvania Railroad, and Mr. J. S. Sullivan, of the Pittsburgh, Cincinnati, Chicago & St. Louis, spoke ably on the subject of "Frame Making and Repairing, and Mr. J. N. Poland presented illustrations of improved methods of making oil welds in locomotive frames.

Oxy-acetylene welding and cutting was described by Mr. T. E. Williams, of the Chicago & Northwestern. Mr. P. T. Lavender, of the Norfolk & Western, described in detail the methods of case-hardening as used at the Roanoke shops, which is as follows: We use a 20 in. by 20 in. by 48 in. cast iron box for case-hardening. A 2 in. layer of burnt bone is placed on the bottom, and the material to be hardened is placed on this about ¾ in. apart, special care being taken that no two pieces touch. Raw bone is packed between each two pieces. When the box is full it is covered with a 2 in. layer of bone and a lid made of boiler plate covers the box. By using this it is not necessary to use fire clay. A semi-muffled furnace having a perforated arch between the box and the combustion chamber is used. This furnace has flues in the wall opposite the burner that runs down to the bottom, giving an outlet under the bottom of the box. This provides a uniform heat. The box is heated to about 1,450 degs. F., and held at that temperature for about 12 hours. The material is then removed and quenched in cold running water. This process gives a casehardening about 1-16 in. to 3-32 in. deep. Mr. D. Huskey, of the Chicago Great Western, also contributed valuable data on the same subject.

Mr. W. C. Scofield, of the Illinois Central, presented a number of shop kinks, among others the cutting off and finishing a spike at one heat, and dies for forming wrenches from scrap spring steel, and appliances for bending cellar bolts in a power punch, all of which were warmly appreciated. Mr. J. W. Riley, of the Lehigh Valley, also showed a number of dies for forming wrenches and forging grab irons. Mr. Thomas F. Keane presented a paper in "Electric Welding," and Mr. W. F. Stanton illustrated methods on making and repairing frogs and crossings.

Mr. George F. Hinkens, of the Westinghouse Air Brake Company, presented a valuable paper on "High Speed or Self Hardening Steel," of which the following is a condensed report:

There are several kinds of self-hardening or high-speed steels on the market, both foreign and domestic. These steels are in many respects very different from each other. At any rate they are included under the designation of self-hardening or alloy steels.

A comprehensive knowledge of the different kinds of self-hardening steels is indeed impossible without an inquiry into the number and peculiarities of the different alloys which they contain. To attempt classifying and arranging these can only be successful when founded upon the general laws governing, or relative to self-hardening steels, and consequently does not belong to this paper.

Tungsten, chromium, vanadium, molybdenum and nickel are the principal alloying elements, and their combinations is not the concern of the tool smith, but belongs to the metallurgist or chemist.

FORGING.

To determine the proper forging heat is a matter of experience on the part of the tool smith. Anywhere from 1650 deg. F. to 1900 deg. F., dependent on the different makes of alloys, is the forging heat used. To ascertain the best forging heat let the tool smith experiment with the particular brand he is to use and forge at the highest heat it will stand. Care must be exercised not to work high-speed steel at too low a heat—forging below the point of transformation, said transformation depending on the alloys. Forging high-speed steel below this point will cause the crystals to crush and rupture. The point of transformation is termed "non-magnetic," or the point of refinement, or that point which releases any strains, or the point of uniformity or equilibrium throughout all parts of the forging; at any rate, it is dangerous to forge high-speed steel after the temperature has dropped below a bright yellow.

HARDENING HIGH SPEED STEEL.

There are as many methods for hardening high-speed steel as there are brands. One method that gives results in hardening high-speed steel is to heat slowly up to the sweating point, or about 2,200 deg. F., after which cool the cutting point of tool in oil (if lathe or planer tool), and when thoroughly black, cool rapidly in compressed air blast. In hardening taps, threading dies, reamers and milling cutters made from high-speed tool steel, it is good practice to insist on slow preheating in a furnace at a temperature of 1,500 deg. F., and then submit to a temperature of 2,200 deg. F., or move to an adjacent furnace.

ANNEALING HIGH-SPEED STEEL.

The methods and material used for annealing high-speed steel are as numerous as the various brands. The Westinghouse Air Brake Company use a very simple method, placing the steel in a tube or pipe large enough in diameter and length to accommodate the work. Both ends of the tube are provided with a screw cap, which can be screwed on and off. After the work is placed in the tube and before screwing on the cap we put in from a tablespoonful to a handful of resin, screw on the cap, place in furnace at the proper temperature, heat for six hours, let the pipe and contents cool with furnace gradually to atmospheric temperature.

The work of large bulk place in open furnace at 1,450 deg. F. and leave in furnace for six hours, then remove and bury in hot burnt case-hardening compounds or extremely hot ashes and let remain until cold.

ELECTION OF OFFICERS.

The attendance was large. The membership now amounts to 323. The election of officers resulted as follows: President, Mr. T. F. Buckley, Delaware, Lackawanna & Western; first vice-president, Mr. T. E. Williams, Chicago & North Western; second vice-president, Mr. W. C. Scofield, Illinois Central; secretary-treasurer, Mr. A. L. Woodworth, Cincinnati, Hamilton & Dayton; assistant secretary-treasurer, Mr. George P. White, Missouri, Kansas & Texas; chemist, Mr. G. H. Williams, Boston, Mass.

Philadelphia was selected as the city where the next annual convention will be held.

Pacific 4-6-2 Type Locomotives for the Lackawanna

The Lackawanna is now receiving from the Lima Locomotive Corporation a lot of fourteen rather interesting locomotives of the Fast Freight Pacific type. These engines were designed under the supervision of Mr. H. C. Manchester, superintendent M. P. & E. of the Lackawanna, whose office is located at Scranton, Pa.

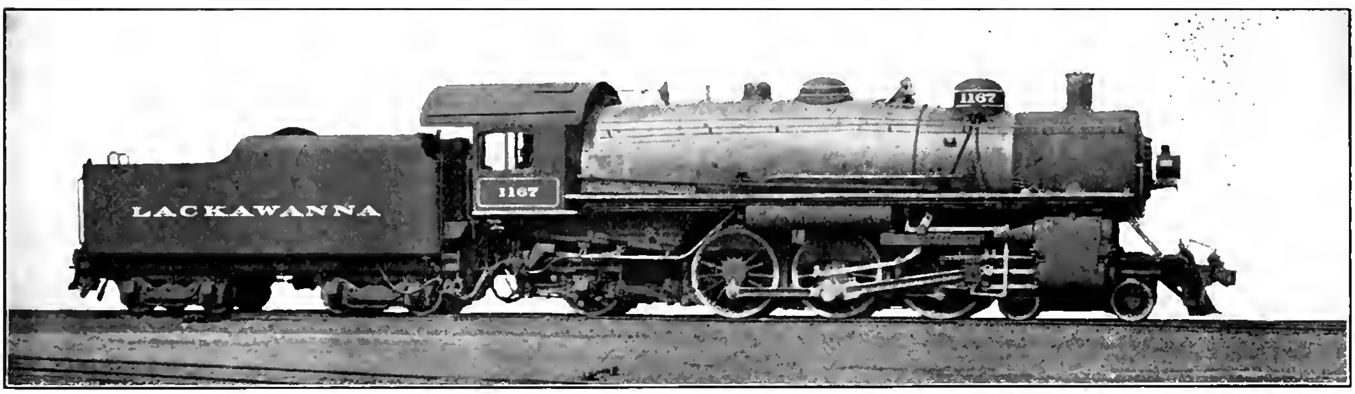
The engines were designed to handle manifest freight trains, and resemble with some improvements a similar lot of engines for the same service secured a year ago, and which have proven very satisfactory in service. The principal item of change in the present engines is the introduction of a 36 inch combustion chamber, with a consequent reduction of the length of flues. This change has enlarged the boiler at its greatest diameter, and added to the engines a slight increase in weight, which doubtlessly has benefited the steaming qualities of the engines, and to some extent added slightly to their hauling capacity.

Aside from the combustion chamber the engines have a number of interesting improvements, as follows: As the engines are frequently expected to do head end work front couplers are provided with Miner friction draft rigging, which in this type is a very compact and satisfactory arrangement. The engine truck is provided with the Woodard inverted link self centering engine truck device; main driving boxes are the long type, 21 inches in length; radial buffers between engine and tender; Franklin butterfly fire doors; Economy type grate shaker brackets, which insure against dropping of fuel through the deck; low type tank wells which provide full opening water supply when in use and when closed permit the water in the tank hose to blow back into the tank so as to leave the hose dry against freezing in winter weather. These tank wells are operated from the ground and entirely dispense with the ordinary upper operating riggings.

The boilers are provided with auxiliary man-hole domes so that the interior of the boilers may be inspected without removal of the throttle valve, and a special form single manifold cab turret is used, so arranged that it can be removed from the boiler for necessary repairs with the full steam pressure on the boiler.

The cylinders are provided with Lackawanna standard by-pass drifting valve arrangement, which provides for the automatic delivery of direct steam from the boiler into the cylinders for coasting periods, which, with the ordinary function of by-pass of the cylinder contents makes the engines very easy coasters. This arrangement also insures greater life of cylinder and piston rod packings, and entirely avoids the carbonization of oil in the cylinders and insures better lubrication when the superheated steam is shut off.

One engine in this lot is provided with additional improved features for experimental purposes. This will be later described.



PACIFIC TYPE LOCOMOTIVE FOR THE DELAWARE, LACKAWANNA & WESTERN RAILROAD.
H. C. Manchester, S. M. P. & E. Lima Locomotive Corporation, Builders.

The engines are provided with Schmidt superheaters and Security arches supported on arch tubes; Tate flexible staybolts in breaking zones; Everlasting blow off cocks; Talmage ashpans; Vanadium cast steel frames; Consolidated safety valves; Delco water gauges; Hancock nonlifting injectors; screw type reverse gear; Walschaerts valve motion; Westinghouse air brake equipment and two 11 inch pumps.

The following are the general dimensions of these locomotives:

Gauge—4 ft. 8½ ins.

Cylinders—25 ins. by 28 ins.

Tractice power—43,200 lbs.

Fuel—Bituminous coal.

Driving wheels—69 ins., over tire.

Rigid wheel base—13 ft.

Wheel base of engine—33 ft. 10 ins.

Wheel base of engine and tender—66 ft. 4 ins.

Weight on drivers in working order—188,000 lbs.

Weight of engine—291,000 lbs.

Weight of tender loaded—165,500 lbs.

Water capacity—9,000 gals.

Fuel capacity—10 tons coal.

Boiler diameter—78 ins. first course, 91⅛ ins. dome course.

Boiler pressure—200 lbs.

Firebox—74¼ ins. by 111⅛ ins.

Grate area—58 sq. ft.

Tubes—265, diameter, 2 ins.; 36, diameter, 5⅜ ins. Length, 17 ft.

Heating surface, firebox, 279 sq. ft.; tubes, 3,279 sq. ft.; total exclusive of superheater, 3,558 sq. ft.

Superheater surface about 1,000 sq. ft.

Furnaces for Hardening High-Speed Steel.

The furnace is a very important essential and should be suitable. There are various designs. The furnace should be so constructed that the oxygen of the air from the blast and fuel opening will not attack the metal, as this would result in scale, blisters, uneven heating, cracking in hardening and general bad results; in other words, a furnace within a furnace, if that were possible. The furnace within heated from the furnace without by flames that are not permitted to enter the inner furnace would be the ideal. Such a furnace would prevent the oxygen of the air from attacking the work and would be suitable for large pieces, such as drop hammer dies. For smaller pieces a muffle should be used.

ABF Equipment.

The Westinghouse Electric & Manufacturing Company has received from the New York Municipal Railway Corporation an order for one hundred sets of ABF control equipment to apply to the second hundred new steel cars which will be used in the new subway. This is a repeat order for the first hundred cars, which cars were fully described in the technical papers, and are giving excellent service.

Catechism of Railroad Operation

NEW SERIES.

Third Year's Examination.

(*Continued from page 327, Sept., 1914.*)

Q. 91. How would you block a crosshead?

A. Securely, blocking it at the back end of the guides where the construction of the engine will permit, or at the front end when necessary.

Note—We block at the rear end when possible so that if the blocking should accidently give way and the crosshead move, the front cylinder head will be damaged in preference to the back head, as the cost of replacing it is far less.

Note—Block the crosshead at the travel mark at the rear end of the guide bars, in that manner preventing the cylinder packing ring from getting down into the counterbore and causing delay in making repairs at the terminal; secure the crosshead by placing a block of wood between crosshead and guide block to hold it at the travel mark, then lash block to lower guide bar between crosshead and front guide block or the back cylinder head; this applies to the "Locomotive" type crosshead and the "Underhung" type of crosshead: but where you have the "Alligator" type crosshead, and desire to block the crosshead ahead, loosen one of the guide bolts with the "plow bolt" head, which holds the lower guide bar to yoke; drive the bolt up so head will be about three-fourths of an inch above the bar; cut the block about one-half inch longer than the distance from bolthead to crosshead; sink bolthead into end of blocking and lash the blocking down on guide bar; this will prevent the bolt from working out and hold the crosshead secure.

Note—Whenever crosshead is blocked remove both cylinder cocks or fasten them open, except when the steam edge of valve seat is broken so that steam will be present in cylinder, which case you will remove the cylinder cock at end where piston head rests and block the cylinder cock open at end of cylinder, where steam is present, to allow condensation to pass out of cylinder—this is to protect cylinder, especially in freezing weather.

Q. 92. What kind of a blow is a valve blow?

A. A steady, constant blow at the exhaust during time the throttle is open.

Q. 93. Is there more than one defect that will cause a valve blow?

A. Yes, two different defects cause a valve blow.

Q. 94. What are these defects?

A. Broken valve packing strips or springs, and the face of the valve or its seat cut or worn hollowing, and in the piston valve the packing rings broken give the same result.

Q. 95. Is there another defect which will cause the steady blow at the exhaust when the throttle is open? And what is this defect?

A. Yes, a sand hole or crack in the cylinder saddle casting between the live steam channel and one of the exhaust channels will cause the steady blow at the exhaust while the throttle is open, but this blow is generally much more pronounced than the valve blow.

Q. 96. How can you tell the difference between the valve face blow and the defective valve packing strip, so that you will make the proper test?

A. The defective valve packing strip, or as it is called, the balance strip, in addition to the constant blow while throttle is open, will have the reverse lever jerking severely in the rack while the engine is in motion, because the balanced effect is lost for that valve and the friction on its seat is excessive.

The cut valve or one of the piston type having broken rings will have the blow, but does not handle hard nor does the reverse lever jerk in the rack, because it still has the balanced effect.

Q. 97. How do you test for valve packing strip blow?

A. Place the engine on the quarter on side to be tested, set the brake, open throttle a little and handle reverse lever, moving it from one corner to the other, noting manner in which the reverse lever handles, whether hard or easily, test the other side in same manner and on the side where the lever handles the harder you will find the defective valve packing strips.

Q. 98. Why do you place the engine on the quarter on side to be tested?

A. So as to move but the one valve which is to be tested.

Note—If both valves were moved you could not tell which valve moved hard, so it is necessary to place the engine on quarter on side to be tested so that the other side will be on the dead center, in which position the valve will not move any with the Walschaerts gear, and with the Stevenson gear it moves very little.

Q. 99. How do you test for a valve face or seat blow?

A. Place the valve on the center of its seat, on side to be tested, open cylinder cocks, set brake and open throttle, if steam shows up at one or both cylinder cocks it indicates a defect in face of valve or its seat.

Note—If the defect does not show with valve on center of its seat it is advisable to move the reverse lever a little, in that manner moving the valve a little on its seat so that if the cause of blow is seat worn hollowing the valve will be raised as it comes out of the hollowed place and show the defect.

Note—Valve may be gotten on center of its seat by placing the engine on the quarter and reverse lever in the center of the rack, or you can get the valve located centrally by getting the rocker arm at right angles to the valve rod.

Note—With the Walschaerts gear the valve is central on its seat when the linkblock is placed in center of link and the combination lever is at right angles to the valve rod.

Q. 100. What would be the first thing you would do if the exhaust got out of square on the road?

A. Ease off on the throttle a little, and see that the lubricator was working all right and feeding properly.

Q. 101. Why is it necessary to ease off on throttle to get the proper lubrication to valves and cylinder sometimes while on the road?

A. Because the steam pressure in chest becomes greater than the pressure in the feed arms, and the current of steam flowing up through the oil pipes holds the oil back from entering the steam chest, easing off on the throttle reduces the chest pressure below that in the feed arms, and allows the oil to flow into the chest.

Note—This trouble may be caused by the main steam valve to lubricator being only partly open, by the equalizing tubes being partially closed by corrosion or lime deposit; or it may be caused by the main steam pipe to lubricator being too small, and not maintaining the high pressure necessary in the feed arms to equalize with chest pressure.

Q. 102. What are the different causes of improper distribution of steam, or of an engine going lame on the road?

A. Lost motion in valve gear and insufficient lubrication, sprung valve yoke, cracked valve yoke, sprung valve rod, sprung rocker arm, loose rocker box, badly worn rocker shaft or rocker box, worn linkblock, link sprung or cracked, sprung tumbling shaft, link lifting arm bent, link hanger too long or too short, blade bolts badly worn, sprung eccentric blade, slipped blade, badly worn straps

or cam, strap bolts loose, cylinder saddles loose and working in frame, and engine frame broken between main driving box and cylinder saddles.

Q. 103. What would you do if valve yoke was cracked?

A. Work the engine full stroke with light throttle, handling full train.

Note—By having the steam follow the piston the entire length of stroke you get the power to handle the train, and by using the light throttle you reduce the steam pressure on top of valve, and consequently the friction on seat and face of valve, therefore the liability of breaking the yoke entirely off is less.

Q. 104. How do you tell when a valve yoke is cracked?

A. The exhaust will be normal when the main pin is passing the front center, and it will be light when passing the back center.

Standing test—Place the engine on the top quarter on side to be tested, with the reverse lever in front corner or quadrant, set the brake, open cylinder cocks, open throttle wide and pull reverse lever back noting position of reverse in relation to center of quadrant when steam ceases to flow from the back cylinder cock; if the lever is back of center of rack when steam ceases to flow from back cylinder cock it indicates that the yoke is cracked or defective.

Note—The friction between valve and seat causes the crack in yoke to open, and the valve is pulled back diagonally on its seat; therefore, the back port will not be closed at the proper time, and many times the front port will be opened and steam be showing at front cylinder cock before the back port is closed.

Q. 105. What would you do if the valve yoke was broken entirely off or the valve stem was broken off the yoke?

A. 105. Disconnect the valve rod and remove the vacuum valve, then with a stick or bar push the valve as far back in the chest as possible, replace vacuum valve, open cylinder cocks, admit a little steam to chest, and with the valve rod push the valve back slowly until a little steam shows at the back cylinder cock, clamp the valve stem in that position, remove the vacuum valve and fit stick of wood in it that will reach the valve when the vacuum valve is screwed back in place; in that manner you will hold valve in position with back port open a little, remove the cylinder cocks and you are ready to proceed. *Do not take down the main rod;* you will lubricate the cylinder and piston rod by having the little current of steam flowing down through the cylinder and out of the back cylinder cock opening; use the lubricator as when the engine is all right.

Note—There is no need of disconnecting a main rod, the main rod or its connections are not damaged, and no large volume of steam is entering cylinder, and proper lubrication can be provided.

Note—Where the cylinders are provided with indicator plugs, they may be removed to establish free circulation of air in cylinders instead of removing the cylinder cocks.

Note—Some heads of mechanical departments desire the valve blocked in central position at all times when it is blocked at all; in that case lubrication may be provided by pouring oil into the indicator plug openings, or by slacking off the front cylinder head and putting small piece of wood in at the top, then tightening up on the studs, pour oil in at the opening thus provided.

Note—Whenever valve is blocked for any cause, except for the broken outer or steam bridge of seat, or the piston is gone entirely from the cylinder, remove both cylinder cocks or both indicator plugs, to avoid the vacuum formation and compression in cylinder, which would be caused by the movement of piston to and fro in the cylinder, and the vacuum and compression if allowed to form would cause serious resistance to the movement of piston in cylinder, causing the cylinder to heat and cut.

The old method of disconnecting for broken valve yoke or stem: Get the rocker arm at right angles to the valve rod clamp the valve stem in that position, remove the valve rod or secure it to clear rocker arm, remove the vacuum valve, and with rod or stick push the valve back against end of valve stem, fit block into vacuum valve that will reach the valve when vacuum valve is in place, securing valve in mid-position in this way then disconnect main rod, block crosshead securely in guides, remove the cylinder cocks, and put collar on main pin.

Q. 106. What would you do if valve was broken to the exhaust cavity?

A. Remove cap of chest, disconnect valve rod and remove the valve from chest, then fit pieces of wood into the admission port where face of the valve was broken, fit blocking into the exhaust port, place valve back on center of seat, using the good part of face to cover its admission port, put cap back on chest and clamp valve steam to hold valve central, provide for free circulation and lubrication and proceed.

Another way—Remove cap of chest, disconnect valve rod, take out valve, put block of hard wood over seat to cover all ports, having it reach from one side of chest to the other; nail another piece of blocking crossways on the seat block which will reach from the forward end of chest to the back end of chest so that it will hold the block over the ports; drive nail hole or bore small hole through seat block into back port, for the steam to carry lubrication into cylinder through; leave valve stem in chest and put cap back on; remove the indicator plugs and you are ready to go. The steam pressure will hold blocking on the seat.

Q. 107. Can you tell whether valve yoke is cracked or eccentric strap bolts are loose? How?

A. Yes, with the valve yoke cracked you will have the normal exhaust as the main pin passes the forward center and the light exhaust as the main pin passes the back center, and with the loose strap bolts the normal exhaust will be as the main pin passes the back center and the light exhaust as the main pin passes the forward center, if the valve motion is indirect, but with the direct valve motion the effect of loose strap bolts is about the same as the cracked valve yoke.

Development of Power Transmission.

In a booklet by James H. Collins distributed by the Westinghouse Electric Company we read: There was a time when primitive man's whole idea of the application of power to work lay in carrying his few possessions around with him. And here begins the path of electrical opportunity. He lugged things around until it occurred to him to make pack animals carry them, and that led to the development of the dray or sled.

It was a great day when he cut his sled runners out of the trunk of the tree instead of from a limb. They turned round then instead of sliding, and much friction was eliminated.

For then the wheel was evolved, and civilization ever since has been pretty largely a matter of wheels—wheels and ways to turn them.

At first it was human muscle at the potter's wheel, and wind or water at the mill wheel, and horses on the chariot. These were the sources of power for centuries, and as long as they were retained the wheel that was turned never got very far from the power that turned it.

By and by, however, steam was utilized to turn wheels, and then came power transmission. Wheels could be hitched to wheels by shafts, gears, belts. One big wheel turned by a steam engine ran hundreds of lesser wheels, animating a whole factory.

Yet even with steam and the mechanical transmission of power, wheels were never made to turn each other at any considerable distance from the prime mover. It is true that cableways with wire ropes running on pulleys supported on piers were successful for distances of several miles—the cable street car was familiar only yesterday. It is true, also, that hydraulic and pneumatic transmission of power was in a very promising state of development yesterday, and is even utilized today under certain conditions.

But, suddenly, something happened to

all the mechanical methods of power transmission.

Electricity came in between the big wheel at the prime mover and the little wheels at the other end, and the face of material civilization was changed almost in a day.

The superiority and wonder of electricity lie in its ability to turn wheels in ways never dreamed of with any mechanical system. It is the ideal and universal form of power transmission.

A copper wire is stretched from the place where power is made to where it is wanted for work. Old limitations of mechanical transmission are utterly disregarded. There are so shafts, belts, alignment. The wire can go up heights, down depths, around any maze of corners, and to distances that are restricted only by questions of economical operation. At one end of the wire the dynamo moves. And at the other end these mysterious waves that we call "electricity" turn a wheel in a motor—the power is available.

Besides turning wheels, electricity can be taken off the wire as light or heat, so it has a three-fold application.

Electricity is the most *flexible* form in which power can be had.

It may be generated in enormous quantities at the central station, by steam or water, and delivered in the tiniest driblets to anybody who wishes to purchase.

Without electricity, there could be no power in the average home.

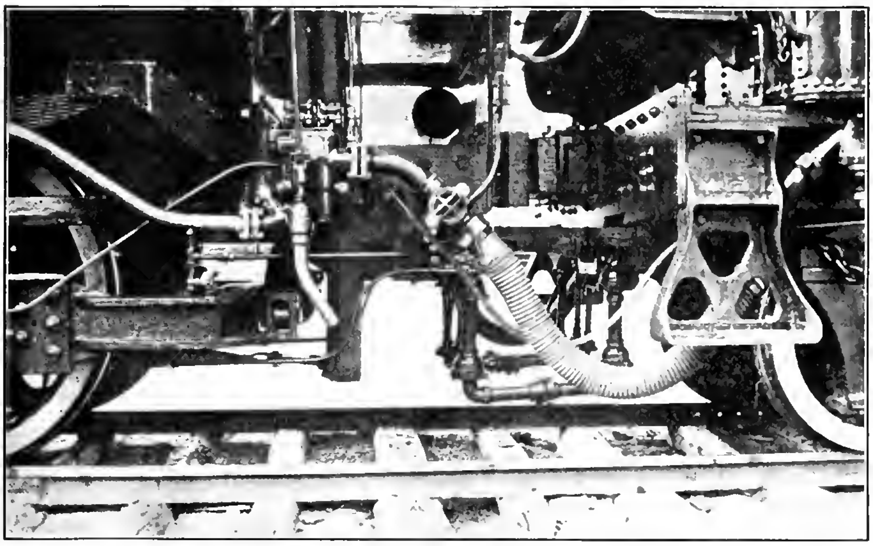
But with electric current from a central station miles away, any home may have cheap power in any quantity. A penny's worth may be bought to sweep a room or chop the hash. Or it may be utilized as heat to iron the towels, or as light wherever needed. Electricity is available instantly, at any hour of the day or night, calls for no skilled attendant, is under perfect control, clean, safe, cheap, and delivers just enough power for the task.

This flexibility, economy, ease of control and cleanliness is just as great in the largest applications of industrial power—machines directly driven by electric motor make the modern factory cleaner, quieter, lighter, more efficient and better in every way.

Prominent Master Car Builder Commends R. R. Club Work.

Master car builders as a rule do not take much interest in railroad club proceedings, but there is one notable exception to this represented by Mr. F. W. Brazier, of the New York Central Lines. At a recent meeting of the Western Railway Club Mr. Brazier remarked:

"I desire to say just a word to the young men who are here. When I look around the room and see less than ten men that I knew when I was president of this club about fifteen years ago, I realize what changes take place in a short time. I came to Chicago in 1893 almost unknown. I attribute my success, meaning where I am today, to attending railway club meetings, taking an interest in them and keeping my eyes open, seeing what I could learn. I never thought I knew it all. I am very sorry my friend De Voy has gone home. He and I always clashed pleasantly, and I would like to have seen more of him. I am now in my 62d year, and at the head of a car department with over 7,000 men, and the car department on my road amounts to something. Motive power men are apt to think that the car department does not amount to very much, but on our road we make them think that it does. We repaired over 2,000,000 cars last year. The car department is the important department on the road, I think, not because I am at the head of it, but because of the loyalty of the men and the pride they take in the work. I want to speak to you young men, because you are the future superintendents of motive power; you will be the future superintendents of the mechanical departments, and I want to encourage you and I want to tell you that I am indebted to Chicago, and I am indebted to my good friends here, and I am indebted for everything that I got here in Chicago, for Chicago is where I got my start, and it is the liveliest and the best railroad center in the world."



HANCOCK NON-LIFTING INSPIRATOR AS APPLIED TO LOCOMOTIVE NO. 1102, D., L. & W. R. R.

James J. Hill's Tribute to the Railroads.

While the railways of the United States may have mistakes to answer for, they have created the most effective, useful, and by far the cheapest system of land transportation in the world. This has been accomplished with very little legislative aid, and against an immense volume of opposition and interference growing out of ignorance and misunderstanding. It is not an exaggeration to say that in the past history of this country the railway, next after the Christian religion and the public school, has been the largest single contributing factor to the welfare and happiness of the people.

The Largest Building in the World.

The largest building in the world is a prominent figure seen from our office windows. It is the Woolworth Building on Broadway, New York, extending from Barclay street to Park place. The building has 55 stories and the great tower rises 750 feet above the sidewalk. The main building is 29 stories high with two stories in the gables on the north and south front. Provision has been made for 34 elevators. The cubical contents of the building exceed 13,200,000 cubic feet. The caissons are bedded on solid rock from 110 to 130 feet below the sidewalk level. Some of the caissons are 19 feet in diameter.

The Singer Building is also visible from our office, and was for a number of years the tallest building in the city. It has 41 stories, and is 621 feet above the street level. Both buildings attract much attention.

Iron Better Than Steel.

Although cast steel is between two and three times as strong as first-class cast iron, the latter metal is far better for some purposes. Cast steel, for instance, is not satisfactory for combustion engine cylinders, and they are invariably made of cast iron. The reason for this is that cast steel expands and contracts with heat twice as much as cast iron. This, of course, is important in anything of that sort.

Questions Answered

DOUBLE PISTONS.

J. H. R., Veidon, Neb., asks: Will you kindly advise me as to what the difference of power in a cylinder with "solid head" with one piston moving one way and a cylinder with two pistons moving in opposite directions taking steam between the piston heads from the same port? A.—There would be a loss of from ten to fifteen per cent., as there is on all kinds of engines on account of the friction incidental to the moving of the mechanical appliances attached to the piston.

TAPER HOLES.

J. R., New Haven, Conn., asks: What is the best method of boring a taper hole? A.—The great bulk of tapering boring work is done with a compound rest, the piece of work being held in a chuck or strapped to the face plate, and the outer end supported in a steady rest. But there are many jobs which can be handled by driving the work on an arbor or mandrel, and setting the arbor over just as though that were the piece to be tapered, except that for boring, the tailstock must be set over the other way. If the taper is one-eighth to the inch, and the arbor twenty-four inches, the total taper would be three inches, and the offset one-half of this, or one-and-a-half inches. With a shorter arbor, say sixteen inches, the offset would be only one inch, and so on in proportion to the dimensions of the appliances and the result desired.

UNITED STATES STANDARD THREAD.

W. K., Joliet, Ill., asks: What are the dimensions of the so-called United States Standard Thread, and why is it so caled? A.—The United States Standard, or Franklin or Sellers thread is so called because it was designed by William Sellers, of Philadelphia, and recommended by the Franklin Institute, and has been adopted by the United States Government. The thread has the same angle as the V, that is, sixty degrees, but has one-eighth of the depth taken off at the top and the bottom. It is always best to use a standard thread gauge as there is an aptitude to fall into error. Grind the tool to fit the gauge for whatever thread is to be cut, being sure that it is a United States Standard gauge.

SMOKE IS CARBON.

I. R. C., Moncton, N. B., asks: Is there at any time any black or brown smoke issuing from either a stationary plant or a locomotive that does not contain carbon? A mechanical engineer of a stationary plant in relating how smoke was analyzed stated that some smoke did not contain carbon. Is all smoke visible? A.—There is no smoke to be seen issuing from the chimney of a steam plant or smokestack of a locomotive that does not contain carbon. Sometimes the gas hydrogen as a product of combustion passes out of a chimney, and has no color, but such gases are not visible. They are not smoke.

LOOSE TIRES.

J. M. K., West Albany, N. Y., asks: What are the principal causes of loose tires, and how can the looseness be discovered before something in the way of a breakage occurs? A.—A driving wheel tire may become loose by being so thin that the action of the rails has the effect of lengthening the metal of the tire until it fails to hold its place on the wheel. This may happen by the tire having been put on two tightly. Such a condition puts the metal under a severe stress, and the limit of elasticity may be exceeded, and the action of the rails soon makes it loose. Or it may have been put on too loose, so that it soon loosens. A sign of a tire loosening will be that the oil will be seen oozing out between the tire and the center. A mark may be made on the tire with a chisel, the mark extending to the wheel, and the engine started when it will be readily observed whether the tire moves or not. The fact that there is no movement, however, should not be taken as conclusive evidence that the tire is not loose. A suspected tire should be run cautiously to the terminal, and thoroughly examined by experts.

POWER OF INJECTORS.

L. M. B., Santa Rosa, Cal., asks: Where does the injector get its superior force to inject water into a boiler against the same steam pressure as is supplied to the injector? A.—The principle on which the injector works is a combination of forces, velocity, and an induced current of water passing through suitably proportioned tubes designated as steam-nozzle, combining tube and delivery nozzle. Under a given pressure the velocity of escaping steam is much greater than that of water, which would be ejected were a hole opened in the boiler below the water line. The reduced orifice in the steam nozzle naturally increases the velocity of the escaping steam as it enters the combination tube where it entrains the feed water and condenser. As the escaping steam is being condensed it loses none of its velocity except that due to friction of the pipes through which it passes, consequently it has a vastly greater penetrating force after condensation than the resistance in the boiler. Leaving the combining tube the condensed steam and feed water passes through the delivery nozzle into the branch pipe, where the force imparted to the water by the velocity of the escaping steam unseats the boiler check, and permits the free flow of water to the boiler.

DISTANCE OF TRAIN STOPS.

M. C. G., Greensboro, N. C., writes: In what distance should a passenger train be stopped under the following circumstances: Train consists of four cars and locomotive. Train is equipped with Westinghouse high-speed brake, and is carrying 90 pound brake-pipe pressure. All wheels braked except engine truck. Piston travel to cars and tender 6 inches, piston travel to driver brake 5 inches. Train is running down grade of 50 feet to mile on one degree curve. Brake is applied in emergency on dry rail while train speed is 45 miles per hour? A.—Without knowing the weight of cars and locomotive, nominal percentage of braking power employed, brake rigging efficiency and minor details that would enter into an estimate of the distance of a train stop, there is no means for finding the overall efficiency of the brake or the average rate of retardation that might be expected from it, hence a calculation of the distance from the information you furnish will be impossible. A comparative estimate is also impracticable as we have no records of train stops of "P. M." equipment, with 90 pounds brake pipe pressure; in fact the use of 90 pounds could be construed to indicate that the foundation brake gear is not of maximum efficiency, therefore the only way in which the actual retarding force of such a brake could be determined is by a test. A fairly accurate calculation of a distance of train stop can only be made after an average rate of retardation is ascertained, and to establish this and analyze all the factors involved necessitates a series of tests and distances of actual stops made with the type of brake in question, thereafter a calculation for this particular type of brake is comparatively simple.

UNDERCUTTING MICA.

R. W. S., Philadelphia, writes: What is the object in undercutting the mica as is done so generally on the commutators of railway motors. A.—This method of cutting is done to prevent "high mica." The mica does not wear down as fast as the copper and if not undercut would stick up a fraction of an inch, causing, first, a burning of the copper segments due to sparking, and, second, a scouring action of the brushes on the commutator.

This condition should be carefully avoided by repeated examinations of the wearing parts of the commutator, otherwise there will be a rapid deterioration of the parts.

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The Traveling Engineers' Convention.

The Traveling Engineers' Convention, held in Chicago last month, was notable for several things in which many meetings of that kind fall very far short. All the subjects that formed committee reports were important from the standpoint of modern railroading, and they were all exhaustively treated and discussed with much thoroughness. At some of the railway and other conventions of a technical character, many of the members consider it fulfilling their entire duty by answering the daily roll calls. The spirit that actuated the members of the Traveling Engineers' Convention was entirely different. Nearly all of them were zealous to put their personal mark upon the business on hand, and every session was well attended by members who were thoroughly prepared to throw new light upon the questions under discussion.

A striking feature of the Traveling Engineers' 1914 Convention was the readiness of a whole host of speakers to express themselves fluently and to the point. At such meetings the presiding officer generally experiences difficulty in prevailing upon well-informed members to take part in the discussions; but at this convention the chairman had difficulty in arresting the flow of eloquence without giving offence to members anxious to be heard. The discussion on Smoke Prevention was particularly exhaustive and brought out a great deal of useful information concerning air admission to the fire that is likely to prove useful in time to come to those striving to reduce the smoke nuisance. It was remarkable how familiar the different speakers were about what had been done in the past towards elimination of smoke and how smokeless firing could be carried out. Only a few years ago a large percentage of the Traveling Engineers' Association held the opinion that smokeless firing was possible only under very favorable conditions, but now the first expression heard was to the effect that smokeless firing was merely a matter of skill and care, especially care.

A most formidable report on "Operation of All Locomotives with a View of Obtaining Maximum Efficiency at Lowest Cost" was presented by a committee of which Mr. I. K. Scott was chairman, assisted by Messrs. P. J. Miller, J. J. McNeill, W. L. Robinson, C. W. Hyde, F. W. Edwards, M. H. Haig and G. W. Tawse. It would be difficult to name an important subject connected with locomotive operation that this report failed to cover and to throw new light thereon. Realizing the magnitude of their subject, the committee circumscribed the investigation to certain prime factors as follows:

"1. Assignment and distribution of power.

"2. Classified or general repairs, when and how made.

"3. Location, application and operation of lubricators, injectors and other boiler attachments.

"4. Terminal inspection and maintenance of locomotives.

"5. Superheaters, brick arches, their care, operation and maintenance.

"6. Selecting, employing, promoting, examining and instructing engineers and firemen with a view of securing and maintaining good service.

"7. Terminal and road facilities for turning and prompt handling of power.

"8. Handling and firing locomotives with a view of obtaining maximum efficiency.

"9. Heat, steam, power and time that is wasted and how to avoid it."

When a practical man examines and analyzes these factors of locomotive management he is likely to receive the impression that nothing of importance has been left out. In order to sustain this impression we cordially invite our readers to procure from Secretary Thompson a copy of this report and to give it the careful study it deserves. The report is of a character that would supply edifying material for discussion to last over a whole convention.

President Underwood Gives Text for Practical Sermon.

In an address delivered by President Underwood, of the Erie, before the superintendents at their New York meeting certain expressions were used which are worthy of becoming railroad proverbs. One expression can be made the basis of an eloquent sermon when Mr. Underwood says, "Seek to instil into every employee the truth that each year of his service improves and cements his relationship with the company—permanency makes for efficiency."

We have been much impressed with an editorial in the *Railway Age Gazette* on the above text and we gladly reproduce the more salient points which read: "In all walks of life, words of censure for misconduct are necessary and are familiar in everybody's experience; while words of commendation for good conduct freeze on our lips. Cementing things together is a process not always easy to explain Chemists tell us that in old brick walls the mortar and the bricks are found to have united in a way which cannot be explained, so that the union between the mortar and the bricks is stronger than the cohesion in the brick itself or in the mortar by itself. So in the relations between employer and employee there is a new cementing each year.

"A superintendent has, say, 100 men of a certain class. Ten of them have been reprimanded or otherwise talked to during the past year concerning derelictions, five have been commended for some specific act, and 85 do not appear on the record. There has been no formal communication covering the quality of their work or conduct It must be presumed that their services were satisfactory. What can be done to better encourage this larger number? They may feel as though they had been ignored. To strengthen their loyalty something more definite is needed. Everybody admits that something ought to be done; but what, when and how?

"One superintendent says that the pay envelope answers the question. Agreeing, for the moment, with this view, it is safe to say that the great majority of officers would like to add something more, even if there be nothing owing to the employee. Should a letter or message go with every pay envelope? That would make the thing too common. The three-line paragraph from the directors, at the end of their annual report to the stockholders, stands at the opposite extreme. This expression of appreciation is so very general that it has no effect at all. A circular

from the general manager, sent separately in envelopes, one to each employee, is an improvement on the directors' method; but still it is pretty vague. Speeches at meetings for "safety-first," or other purposes, are also unsatisfactory.

"The need is for an individual communication; a letter or message known by the recipient to be based on thoughts concerning him, and referring to no other employee. On one road, the name of which we do not recall, a brief commendatory letter was sent, one December, to each employee whose record for 12 months was clear, and the result was very gratifying. Credits for specially meritorious acts, to be entered in a printed monthly bulletin, are now common on many roads. These seem to be quite generally liked; but one hears frequently the objection that it is not good practice to commend a man for doing his simple duty. To make a distinction between what is in the line of duty and what is not, is often difficult. And there is the more serious objection that the rewards are very unequal. The most vigilant telegraph operator may wait five years, or even ten, before he sees a fallen brakebeam in a passing freight train; while some comparatively lazy young novice may in the meantime get his name in the record by good luck. The publication of these commendatory bulletins, however, is a move in the right direction. If any ill effects shall result from their use, the need will be not for abolition but for correction. Can this feature be improved?"

Proper Proportions of Locomotives.

The locomotive engine is an excellent example of evolution, the proportions best suited for making an efficient engine having been settled upon by the tentative, or try again, process. The individuality for which motive power officials have been celebrated all over the world has tended to diversify the relative proportions of locomotive parts, such as boiler surface to cylinder magnitude, and these days of immense sizes and weights have not tended to bring about agreement as to what the proportions of cylinders and driving wheels to boiler and adhesive weight ought to be. While diversity seems to be growing worse confounded, it may be well to consider some reports of the American Railway Master Mechanics' Association, being the results of careful investigations of the proportions of locomotive parts that produced the most efficient engine.

In an admirable report adopted by the American Railway Master Mechanics' Association years ago, a judicious compromise was effected between conflicting claims, and rules for dimensions were laid down which were plain, simple and comprehensive. That report establishing standard ratios between the power applicable for turning the driving wheels and the weight available for adhesion has exerted a most important influence upon locomotive designing, but the rules and formulae have been ignored by not a few designers and people ordering locomotives, so we consider that a brief discussion of the subject may have a profitable effect.

When people first began to experiment with engines on wheels, the tendency was to apply more power to turning the driving wheels than was warranted by the weight available for adhesion, with the result that the wheels slipped so badly that cog-rack rails were introduced on some of the pioneer railways. Experience paved the way out of this difficulty, and the first high-speed locomotive, Stephenson's "Rocket," hit a happy medium between tractive power and adhesive weight, although the proportions of other parts were changed on engines subsequently built. The "Rocket" had cylinders 8 x 16.5 inches, and the boiler had 138 square feet of heating surface. This give 1.37 square feet of heating surface to each inch of cylinder diameter and one square foot of heating surface to 12 cubic inches of cylinder content. The cylinders were doubtless found too large for the boiler, as in the locomotives built immediately afterwards the ratio of heating surface to cylinder volume was materially increased. The "Planet" class of Stephenson engines and the early Bury locomotives had cylinders 11 x 16 inches and about 300 square feet of heating surface. This gave a little over 2 square feet of heating surface per inch of cylinder area and about one square foot of heating surface for 8 cubic inches of cylinder content. This was a high ratio of heating surface to cylinder capacity, and the engines built with these proportions were noted for efficiency.

It is difficult to ascertain the boiler dimensions of early American locomotives; but the indications are that the practice of overcylindering the engines that became a serious and notorious evil began early, although there were exceptions made by some builders. A famous Norris engine, exported to England in 1839, used with great success in operating a steep incline on the Birmingham & Gloucester Railway, had cylinders 10.5 x 18 inches and 362 square feet of heating surface, giving a ratio of one square foot of heating surface to 8.6 cubic inches of cylinder. The "De Witt Clinton," the first locomotive built in New York State had about the same proportion of heating surface to cylinder as the "Rocket" and Baldwin's first locomotive "Old Ironsides" had one square foot of heating surface to 11 cubic inches of cylinder.

It is a good illustration of how readily people accept custom as being good business that until about the beginning of the Twentieth Century, very few heads of railroad motive power departments paid much attention to the relative proportions of cylinders and heating surface, for we often find that engines with different sizes of cylinders were equipped with one size of boiler, although both engines were to be employed upon the same service. This was a method of design that admitted of great nominal latitude as to the power of locomotives. The methods of estimating locomotive capacity were ridiculous and indicated a very low scale of intelligence among railway master mechanics and locomotive builders. An increase of one inch in cylinder diameter was supposed (not estimated) to increase the power of the engine ten or twelve per cent. That change in dimension would also be likely to increase the coal consumption twenty per cent., and the rapidity of wear fifteen per cent. Through an erroneous principle the price of locomotives was based upon cylinder capacity. This made the builders directly interested in making the cylinders large and the boiler small. Until well into the Twentieth Century we never were aware of any locomotive builder claiming any merit for supplying large boilers in proportion to cylinder capacity.

The writer was once directly interested in a transaction in new locomotives that seems very edifying many years after the thing happened. The heaviest type of locomotive belonging to a certain railroad company had cylinders 17 x 24 inches and driving wheels with 56 inch centers. The engines worked fairly well, but in placing an order for a group of new ones, the request was made that they should be a little heavier than the old engines. The order was filled in due course and the new engines were found to have cylinders one inch greater diameter than the old ones, but the heating surface and all other parts were of the same size as those of the old engines. The price charged for the new engines was, however, fifteen per cent. greater than the price paid for the old ones. It was found in practice that the new engines were over cylindered and they never did the work of train hauling as well as the old ones.

Machinery Accidents.

As legislatures in nearly every state of the Union have recently been passing laws for the purpose of protecting the limbs and lives of industrial workers, we wish to direct attention to the fact that familiarity with appliances that may prove dangerous does not always tend to make men wise. Indeed, in some cases it is the ancient trouble of familiarity breeding contempt of danger. How else can we account for the sad and sickening, almost tautological repetition of accidents resulting solely through the careless use of machinery, year after year,

although the fullest light of experience has been thrown in each case on those who have owed their death, perhaps to nothing but their own astounding folly and gross carelessness beyond all belief? In the case of accidents connected with the manipulation of machinery this is the more strange, as the worst and the most deadly disasters generally befall those who are most intimately acquainted with the nature of the mechanism in whose midst they are probably moving daily.

Let us particularize. We believe a good many casualties are due to the careless handling of belts, and especially the throwing them on or off pulleys in motion. There is, of course, a right and a wrong way to put on a belt. One speaking from actual experience says: The belt should be first placed on the pulley at rest, and then run on to the one in motion. In some cases where the belt is heavy or the shaft runs very swiftly, it is best to slacken the speed so that the shaft barely moves. Where this is impracticable great care should be observed in mounting the belt on the pulley fan. The operator should have a firm and solid foothold, and one that no part of his person or clothing gets between the belt and pulley. Then again, belts from running overhead shafts are frequently run on or off by means of a long stick, the operator standing on the floor. In throwing a belt off the danger of accident is not great, but in running a belt on in this manner the stick is liable to be caught and thrown with great violence, at the hazard of breaking human heads or valuable machinery. Such a practice as this is very dangerous. Sometimes a very careless operator will stand on the floor and just cast the belt on the face of the revolving overhead pulley. Once on it must be held motionless in its place with one hand against the friction of the pulley face, while the other hand guides it on the loose pulley of the machine, or the tight pulley, if there be no loose one. The danger surely is obvious—the belt may catch in a projecting key, or the head of a set screw, or double under on the shaft, when it will wind up with a velocity corresponding to the speed of the shaft, and perhaps carry the workman with it.

Besides these special perils we have the reprehensive practice of using fast and loose pulleys without a belt guide, which too often leads to deplorable accidents. A noteworthy instance has been recently recorded in a contemporary. A man was adjusting a pair of steam-power shears, and by some means, and all unexpectedly to him, the belt on the loose pulley worked over on the stationary pulley, and set the shears in motion. His left arm at the time was between the blades, which, closing with great force, nearly severed the arm near the wrist, cutting through the flesh and bones, and leaving the hand hanging by a few tendons and the skin. The arm was amputated near the elbow.

Ideal Enginemen.

A high official of the Baltimore & Ohio Railroad put himself on record recently by praising the highly intelligent way the enginemen of the company had acted in operating mechanical stokers that had been put upon many locomotives belonging to the company. One of the most hopeful signs of the times for the economical operation of railways is the active interest displayed by locomotive firemen in all matters pertaining to the management of the locomotive. The indications are that the officials performing the duties of selecting firemen display much care in choosing the men suitable for the duties which the men are expected to perform. The present fireman is the future engineer, and the locomotive engineer can do more to save or to waste the employer's money than any other railway man. The fireman of the past was satisfied if he could learn to handle the engine in any way that would enable him to make running time when his turn to sit on the right hand side came around. His principal ambition as a fireman was to keep the safety valves blowing when the engine was at work. From rather extended observations we have come to the conclusion that the fireman of today is striving to find out how he can induce the engine to make running time with the least possible expense for fresh lubricants and repairs.

Men who are occupying their minds with schemes for making the engine work more economically than it ever worked before will give a good account of themselves as locomotive engineers. Meanwhile we would caution these anxious inquirers after knowledge against imagining that they have learned the whole business because they are able to take part in the discussion of engineering questions. To the young man starting out we would respectfully give the following advice from an old and very successful engineer that has already been in print:

When a fireman is promoted to the position of engineer, he, as a general thing, wants every person to know that he has taken possession of the right hand side of the cab, and will try to make faster time than the old men, and will feel indignant with all his companions on the road if they fail to pay him the admiration he considers his due. Any mistake made by other trainmen will bring forth protest in words not found in the dictionary. This is not the way to become popular or successful. A better way is for this young runner to make himself familiar with all train rules and regulations issued by the company he is working for; particularly should he become thoroughly acquainted with the schedule rights of trains, and understand all telegraph orders before signing them, and then carry them out to the letter.

Young engineer, when you arrive at the end of the trip you must always have plenty of water in the boiler and must make sure for yourself that such is the case. Look around your engine carefully and if you discover any loose nuts tighten them. Cultivate the habit of examining the motion for defects because that is an engineering accomplishment easy of development. Enter notes of defects in the book kept for the purpose, but never report work unless it needs to be done. If you do, the roundhouse foreman will come to the conclusion after a time that you want to make yourself conspicuous and will not pay much attention to your reports. After you go home or to your boarding house wash and eat your meal. Don't in the evening go to some saloon frequented by railroad men and get "blowing" what kind of a run you made, and that conductor so and so is of no account, and if you could get all the work you reported done to the engine you could pull more cars than any engine on the division. Never do any railroading when you are off your engine, you have enough to do while there.

Never talk ill about your fellow employees and especially the officers under whom you work. They may have their faults, but it is not your business to correct them. Be kind to your fireman and co-operate with him as far as it lies in your power. Be courteous to strangers, and if they ask questions about your work answer as intelligently as your knowledge will admit and remember that you may be entertaining angels unawares. That has happened before. Be sure you are right, then go ahead. In case of doubt take the safe side.

Knowledge Is Power.

Spanish words and phrases are made plain to anyone requiring that line of knowledge by the Joseph Dixon Crucible Company who have issued a little pamphlet entitled, "Useful Spanish Words and Phrases." The little pamphlet is simply intended as an aid to those who desire to make their wants known and is not intended as a treatise on the Spanish language.

A copy will be sent to anyone interested by addressing the Joseph Dixon Crucible Company, Jersey City, N. J. Do not hesitate to send for it if you need the increase of knowledge, and whether you need it or not there is no danger in knowing too much and it is always a sure sign of a trained mind and a keen intellect to have some mastery in languages, living or dead, especially living.

Air Brake Department

Operation of A. M. M. Equipment.

Last month's issue contains views of the brake valve and triple valve of the A. M. M. equipment, and it is now desired to give a very brief description of the operation of this brake.

With the main reservoirs charged, and the brake valve handle in release position, the compressed air flows through the brake valve into the brake pipe triple valve and auxiliary reservoir, charging them to the pressure to be employed, and it will be noted that the double check valve has a connection with the auxiliary reservoir.

The control pipe, which is used principally for graduated release and high pressure emergency, as well as for quick recharge, is charged from a separate feed valve which also supplies the brake valve from the main reservoir.

To apply the brake with an automatic service application, or when it is desired to apply the brake on other cars that may be coupled, the handle is placed in automatic service position, when the brake valve discharges air from the brake pipe to the atmosphere at a given rate, and the triple valve responds in the usual manner, working in quick service to hasten the brake pipe reduction, and admitting air from the auxiliary reservoir through the double-check valve to the brake cylinder applying the brake.

The application ceases with a return of the handle to automatic lap position, or if left in service continues until the auxiliary reservoir and brake cylinder have equalized in pressure.

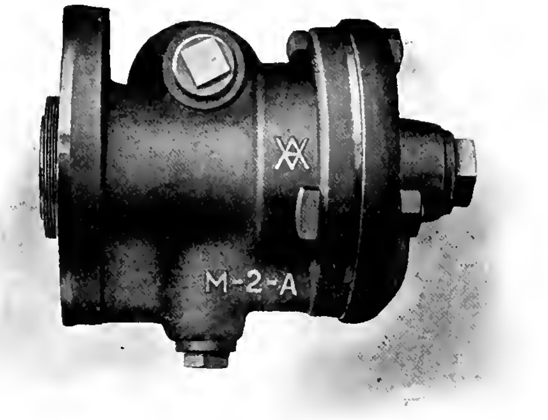
When a release after an automatic application is desired it can be made straight is maintained against any leakage.

The release after emergency is accomplished by returning the valve handle to release position, restoring brake pipe pressure and recharging the auxiliary reservoir.

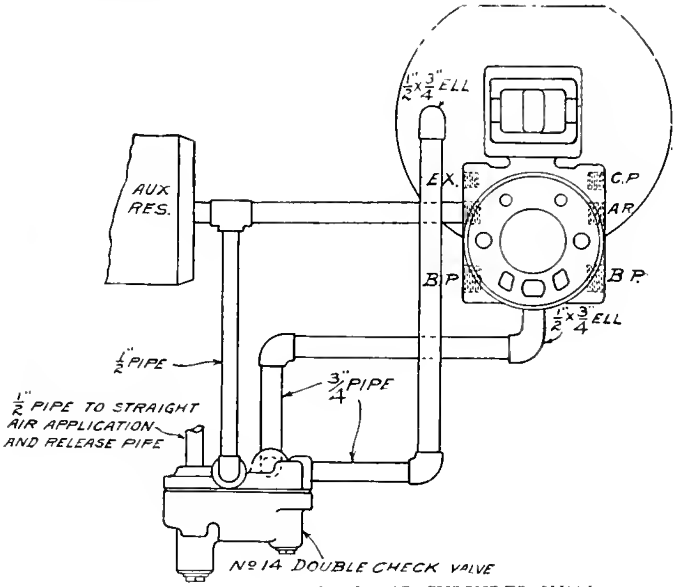
As our purpose is to merely give an idea of the operation of this brake, we think this will suffice as complete instructions covering manipulation, operation and care of the equipment accompany any installation, or are furnished to any one interested upon application to the manufacturers.

Brake Valve Repairs.

Repairing a defective brake valve, as practiced in some railroad repair shops, is an operation that is governed by the



No. 2-A—TRIPLE VALVE.



PIPE CONNECTION TO BRAKE CYLINDER HEAD.

To apply the brake on the motor car alone the valve handle is moved to straight air application position, wherein the brake valve admits air from the main reservoir to the straight air application and release pipe, which enters the double check valve back of piston No. 4, which when moved unseats a check valve, admitting auxiliary reservoir pressure as well as straight air pipe pressure to the brake cylinder.

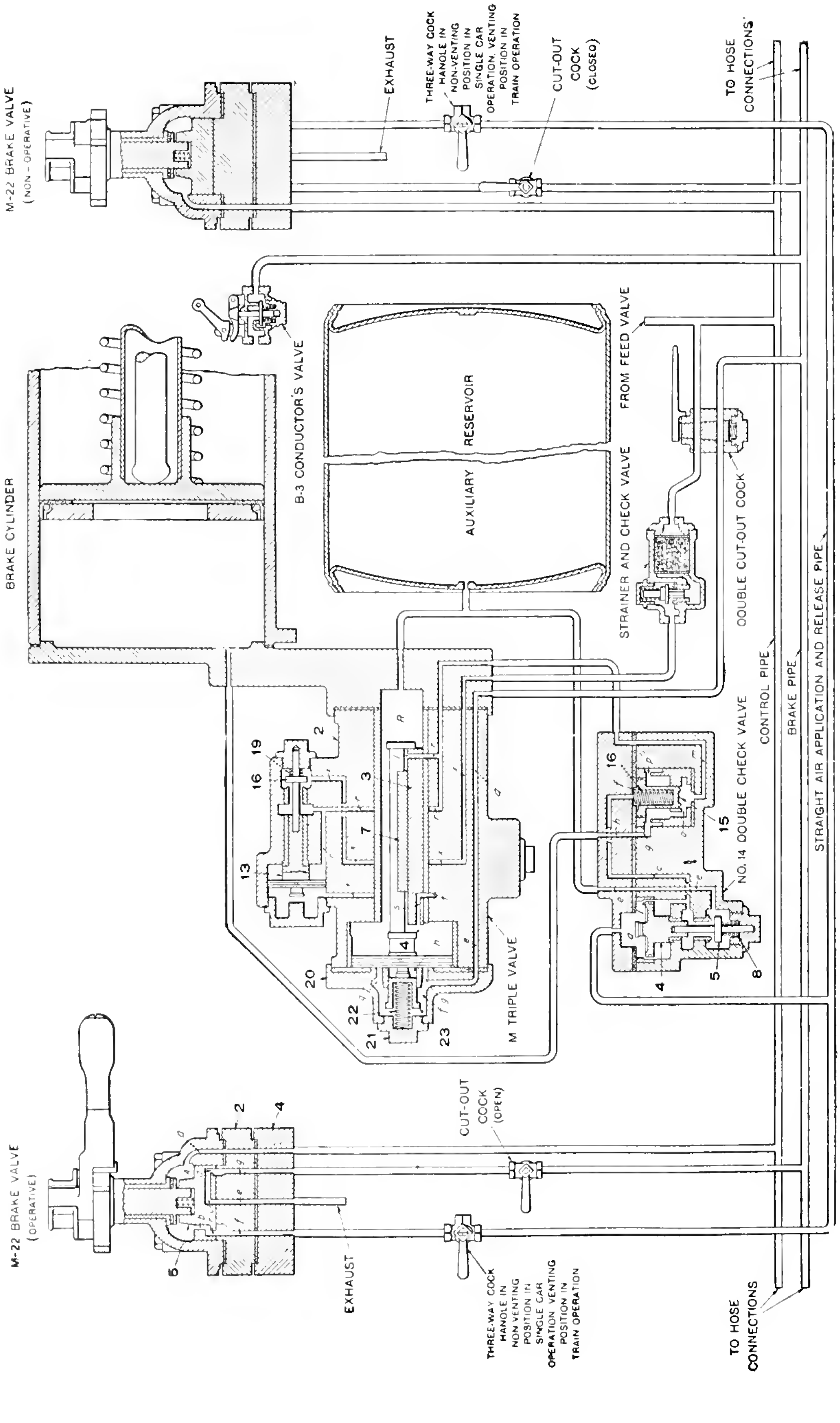
When the brake is applied with sufficient force, the brake valve handle is returned to straight air lap position, cutting off the flow of air through the brake valve.

When it is desired to release the brake, the handle is returned to release position, and the brake cylinder pressure escapes through the double check valve and brake valve to the atmosphere.

away by moving the brake valve to release position, or can be graduated off in any amount by alternating the handle between release and automatic lap positions, or between straight air lap and automatic lap positions.

In cases of emergency the valve handle is moved to emergency position, and a large opening is suddenly made in the brake pipe, with the result that the brake is applied in full in the shortest possible time, as the sudden reduction causes the triple valve piston to travel its full stroke, operating the by-pass piston to produce high-pressure emergency by admitting control pipe pressure to the brake cylinder. In this position, brake cylinder pressure also enters through the double check valve, and brake cylinder pressure

work report of the locomotive and the time consumed in making the repairs is sometimes governed by the time the locomotive remains in the engine house. It is sometimes possible to make a passable job of fitting a packing ring or scraping the high spots off a rotary valve and its seat without removing the entire valve from the engine, but we would advocate a removal and test of the repaired valve before it is again returned to service. When a brake valve has been in service long enough to require a new packing ring or a re-facing of the rotary valve and seat, it should be removed from the engine and thoroughly boiled in a lye vat to remove the burnt oil and other restrictions from the ports and passages, and after this is done the valve can be



A. M. M. EQUIPMENT IN EMERGENCY.

examined with a view of making any necessary repairs.

When the valve has been cleaned, the bearing of the rotary valve on its seat can be found by sprinkling a small quantity of flour of emery on the face of the valve and rubbing it on the seat. If an imperfect bearing is found, the distance from the upper edge of the rotary valve to the portion of the seat upon which the upper body gasket rests, should be measured to determine whether there is sufficient metal to permit of a re-facing without incurring the liability of the rotary valve key becoming disengaged from the valve when it is again placed in service.

In the G6 brake valve this distance is 2 inches when the valve and seat are new, and the distance should not be allowed to reduce to less than 1⅞ inches. If the distance can be made 1⅞ inches by the application of a new rotary valve it should be done, but if a new valve does not increase the distance the desired amount, the seat should be scrapped and the old rotary valve used on a new seat if the distance is correct. Removing more metal than is specified will create a tendency for the valve to become disengaged from the key after the valves are again in service.

To be positive about this distance in any type of brake valve, place the valve, key, upper gasket and body in position, with the rotary key gasket and valve spring removed, then by marking the key at the point it extends through the body and drawing it up as far as it will come, and making another mark on the key will show how far the key can lift in the valve when the rotary key gasket is entirely worn out. Subtracting the distance from the original scant ⅜ of an inch engagement of the valve and key leaves the amount of engagement when the rotary key gasket becomes entirely worn out.

After this part of the brake valve is known to be correct the preliminary exhaust port bushing should receive attention; if it is enlarged beyond 1/16 of an inch it should be re-bushed.

Bushing this port in the average railroad shop consists principally of plugging the port with a piece of brass of the proper length, shaping up the upper edge with a 3/16 drill, and drilling through with a 1/16 drill.

The measurements and size of port opening through the bushing being correct, the highest points on the valve and seat can be found by the use of a scale, if considerable wear is shown the surfaces can be trued up on a lathe, but if the wear is only a slight amount, a fine file can be used on the high places on the valve and seat. Only an experienced workman should be permitted to use a file on the valve or seat as a few misplaced strokes can practically ruin one of the parts.

The valve and seat should be rubbed together dry, the high places noted and scraped off. Grinding in a rotary valve is merely a meaningless expression. Grinding material should not be used. The use of lead or a similar substance to find the bearing surfaces is a mistaken idea. The way to find the actual wearing surfaces is to rub the valve on the seat when it is perfectly dry. When the valve is finished dry it will leave a hard, highly polished surface that will outwear any valve that can be finished by grinding. Leaving the bearing a trifle heavier near the center of the valve than at the outside will avoid a hard handling brake valve. Removing the pin from the center of the rotary valve, and replacing it after the work is completed is merely a waste of time. With the H6 or S6 valves a brass band can be made to fit loosely around the valve seat and extend a trifle above it to keep the valve in place when revolving it on the seat to find the bearing. Covering a valve and seat with a mixture of oil and grinding compound is a very poor practice as small quantities of the mixture adheres to the edges of the port openings and cuts into the brass, whereas if the work is done with a dry valve and seat there is no possibility of lengthening any of the ports.

When the valve and seat are finished the ports should be thoroughly blown out with a jet of compressed air or steam.

Lost motion between the valve and key, the key and body and the key and handle should be taken out. Very often the application of a new rotary key takes up all of the lost motion, but if a new key is too loose in the valve body, the body or case should be renewed as too loose a key means a constantly growing leakage from the rotary key gasket.

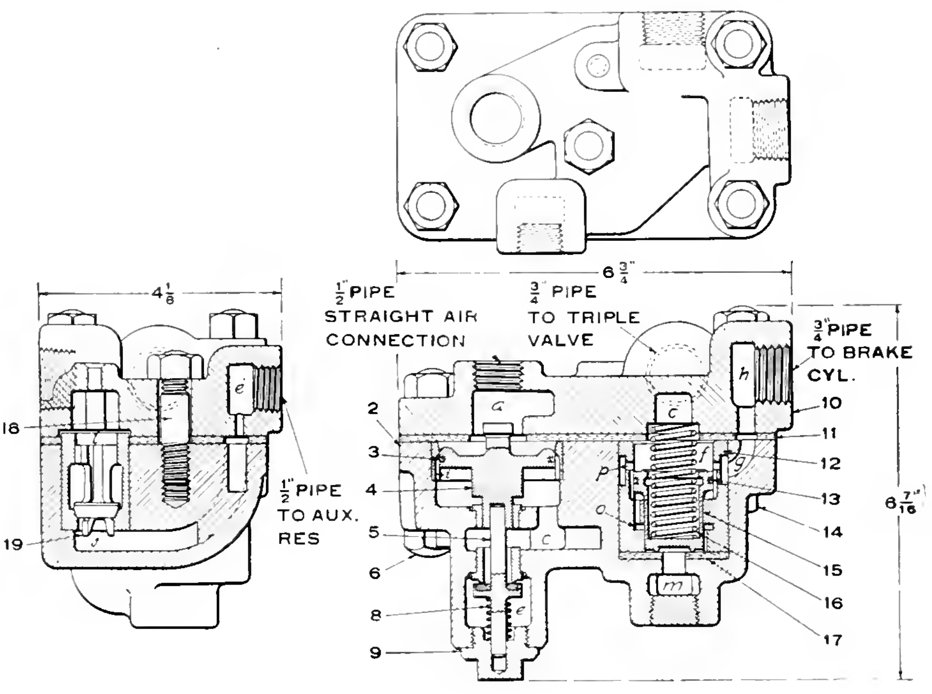
Before applying a new key it should be fitted into the rotary valve, and any blurs that would tend to stick the key in the valve should be removed. The handle should be a tight fit on the key; an old handle can sometimes be tightened on an old key by mashing it in a vise, but it is preferable to use a new handle if the old one cannot be made to fit a new key.

When the lower portion of the brake valve is reached the threaded portion should be examined, and if the exterior is found free from any defects, the bushing should be examined with a view of determining the amount of wear. Any ordinary shoulder can be scraped out in a few seconds' time by the use of a scraper with a perfectly straight edge, but if the bushing is enlarged to an extent that it is difficult to fit a ring the lower case should be rebushed.

When the packing ring is fitted it should fit the groove of the piston as well as the bushing, and it should be rubbed in dry until a perfect bearing surface is obtained at all outside points on the ring, and the rubbing must be continued until the friction is reduced the proper amount.

After the valve is assembled, and the necessary parts are lubricated, the valve should be tested on a rack that will permit of its controlling a very small, as well as a very large, volume of brake pipe pressure.

When testing the H6 brake valve, note that the equalizing reservoir is drained when the handle is in emergency position, also that the maintaining port is open, which is indicated by a constant popping of the safety valve of the distributing valve. When correct move the



No. 14—DOUBLE CHECK VALVE.

handle to lap position, and disconnect the excess pressure operating pipe, note that there is a strong blow when in release, running or holding positions, and no leakage whatever when in the other three positions of the brake valve.

Make a 10 lb. brake pipe reduction after connecting the operating pipe, and note that there is no leakage from any of the exhaust ports, and note that the warning port is open. In service application position, the equalizing reservoir should reduce from 110 to 9 lbs. in from $5\frac{1}{2}$ to 6 seconds.

With the valve in running position the application chamber should reduce in pressure from 50 to 5 lbs. in from 3 to 4 seconds.

Test the equalizing piston by making a number of light reductions, and noting that the piston lifts and cuts off perfectly after each reduction.

In testing the S6 brake valve the same care as to leakage should be observed, note that the warning port is open, and that the return spring returns the handle from release to running, and from quick to slow application positions as the hand is removed from the handle, and know that there is no leakage from the exhaust port. In slow application position, 40 lbs.' application chamber pressure should be obtained in from 6 to 8 seconds, and in quick application position, in from one to two or in less than 2 seconds.

After a 20 lb. reduction with the automatic brake valve, and return to lap, the independent valve should exhaust pressure from the application chamber and cylinder from 50 to 5 lbs. in from 2 to 3 seconds.

The foregoing will show up a leaky rotary valve, but if there is any doubt the stop cock under the brake valve can be closed, and with the brake valve handle on lap a rise in pressure will indicate a leaky automatic rotary valve. In case of doubt on the part of the S6 valve the application cylinder and release pipes can be disconnected and tested for leakage from the rotary valve.

Coining Words.

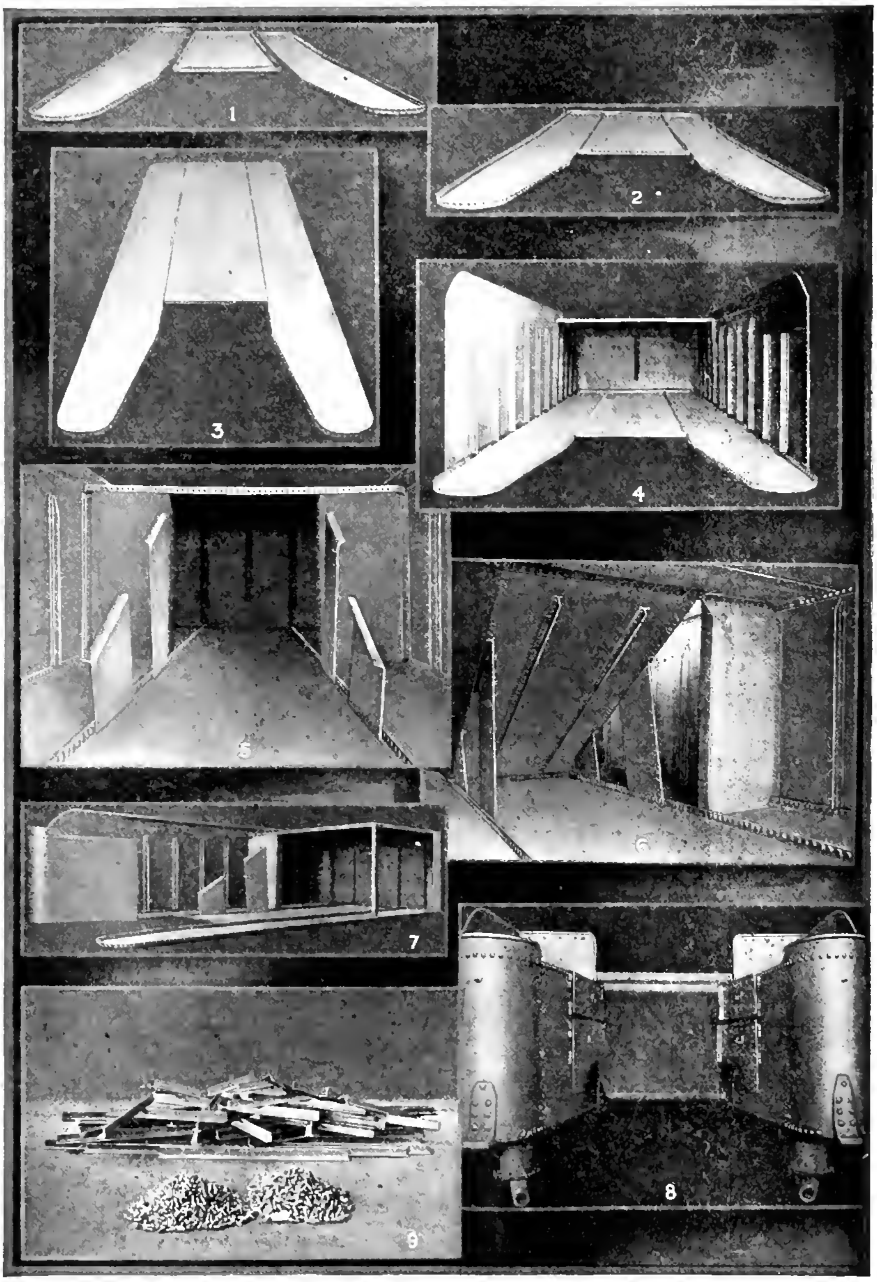
The esteemed Weather Bureau has sprung a new one. It is the word "smog," and it means smoke and fog. The bureau explains that very frequently there are times when this mixture is apparent in the atmosphere, and it considers the new word a great little idea.

Very well, "smog" let it be. But why end there? Let's call a mixture of snow and mud "smud." A mixture of snow and soot "snoot" and a mixture of snow and hail "snail." Thus we might have a weather forecast:

"Snail today, turning to snoot tonight; tomorrow smoggy with smud," and so on *ad infinitum.*

Acme-Flanged Sectional Locomotive Tank

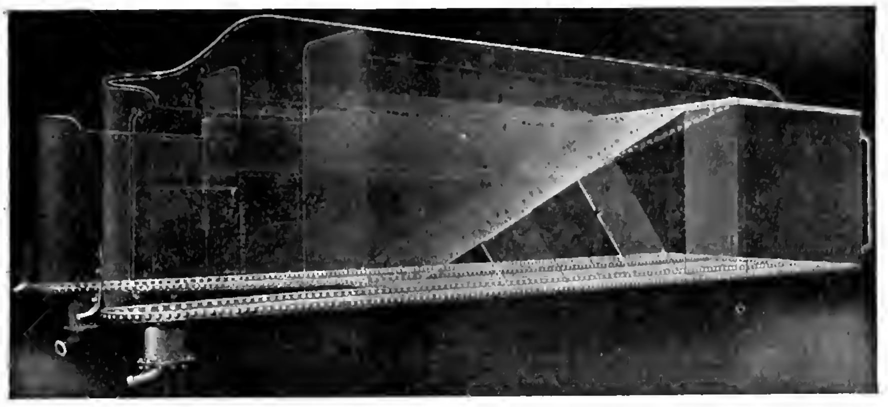
The popular favor with which the introduction of the Acme-Flanged Sectional Locomotive tank is being received bids fair to increase with the coming demand for increased railway supplies. During the short time since the improved locomotive tank was placed on the market over 200 are now in service, while orders are being negotiated for on a number of the leading railroads. The principal advantages of the marked improvement in the Acme-Flanged tank are that the tank, being formed from plates with edges turned towards the water space, the necessity for placing rivet holes in the top or bottom is eliminated. The tendency to leakage is thereby reduced to a minimum, and as a consequence the cost of maintenance is largely reduced. As is well-known the flat bottomed tank of ordinary construction must be lifted off the deck every time it is necessary to renew or calk rivets or calk the seams. The construction of the Acme-Flanged tank is such that the entire bottom rests firmly and smoothly on the tank floor or deck, and consequently there are no strains by reason of the usual uneven surface of the tank bottom.



DETAILS OF THE ACME-FLANGED SECTIONAL LOCOMOTIVE TANK.

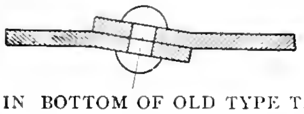
There are other important improvements to which attention need only be called to show at a glance their merit. Among these are the methods of sectional construction as shown in the accompanying illustrations. The center section or fan is directly under the

water intake, and tends to retain pieces of coal, cinders and sediment passing through the screen, and preventing them from reaching the side fans and clogging the injectors. The construction

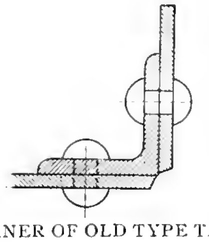


SECTION VIEW OF THE ACME-FLANGED LOCOMOTIVE TANK.

throughout is strong and simple, and gap riveter is used instead of the "gun" type of riveter in the top and bottom flanges. The complete absence of angle and tee irons, and sharp corners in the interior of the tank, also aids in prolonging the life of the bottom of the tank. Records of service have already shown that the cost of maintenance has been greatly reduced by the introduction of the Acme-Flanged sectional tanks.



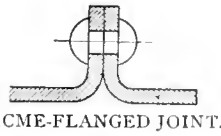
SEAM IN BOTTOM OF OLD TYPE TANK.



CORNER OF OLD TYPE TANK.

The illustrations showing the method of construction are of interest, and embrace, besides a general view of the tank in section, the parts separately numbered and other details. Fig. 1 shows flanged bottom sections set a little distance apart before starting to bolt temporarily. Fig. 2 shows the sections temporarily bolted and ready to rivet. Fig. 3 is a view of the under side of the

SECTION OF ACME-FLANGED TANK BOTTOM, SHOWING METHOD OF RIVETING SECTIONS TOGETHER.



ACME-FLANGED JOINT.

bottom sections showing smooth surface and absence of rivet holes. Fig. 4 is an interior view of partially completed tank. Fig. 5 is an interior view showing braces riveted in place. Fig. 6 shows slope sheet in place, showing relation of braces to the same. Fig. 7 shows braces and splash plates in position on one side. Fig. 8 is a front view of finished tank showing slope sheet, coal gates and tank lugs. Fig. 9 is an instructive view of angle irons, tee irons and rivets necessary in the construction of the old style of tank, but are dispensed with in the Acme-Flanged tank.

Development of Manipulative Skill.

Wherever we find an article that displays skill in finish or construction we may conclude that it came from the hands of a skillful workman. We may also safely decide that the person who performed the work acquired the necessary skill by years of diligent labor.

Among the most ancient products of skill and industry preserved in our museums are weapons that had been used in Assyria. From this we are led to believe that systematic efforts to acquire high skill by workmen was first devoted to the making of weapons. Unfortunately the whole history of the world indicates that high skill was most readily employed in the production of weapons intended to destroy human life.

A sister industry to that of sword making was that of cutlery, which is a very ancient craft. In modern times the cutlers formed very close guilds, and were very strict in admitting members. One of the closest of these guilds was composed of the cutlers of Sheffield, England. Among the rules of the Sheffield guilds was that no master, servant or apprentice shall perform any work pertaining to their service or mystery for eight and twenty days ensuing the eighth day of August each year, nor from Christmas to the twenty-third day of January.

No person was allowed to work at the trade who had not served an apprenticeship or service, or had been instructed by his father for that term. Sons generally followed the trade of their father, and the "mysteries" were handed down from generation to generation. There were advantages in learning the trade in the family circle, for strict penalties were inflicted upon cutlers having more than one apprentice till the old one was in his last year, and none was taken on for a term less than seven years. These people held very restricted views on the protection of their industries, for no occupier of a wheel was permitted to allow any person to grind or glance any knives or other cutlery instruments there who did not reside within the "lordship," and no one was suffered to follow the trade except in the place where he had learned the trade.

That seven years' period of apprenticeship was almost universal, and was entirely so in the metal trades. Railway companies exerted much influence in breaking down the seven years apprenticeship. Most of them introduced the practice of making four years the term of apprenticeship, and other lines of industry had to follow suit.

Pennsylvania Testing Plant.

The Pennsylvania's testing laboratory and electrical departments at Altoona are now being moved into the new $80,000 building erected for their accommodation. One of the new machines installed has a crushing pressure of 1,000,000 pounds, and will be used for determining the lifting strength of car connections. In the electrical department is a light globe with a capacity of 960 bulbs at one time. The floors of the building are an experiment. On a five-inch layer of sawdust has been placed a covering of one-half inch of red cement. The process was discovered in and the materials imported from Greece. The effect is to deaden sound and the floor is also easier on the feet of the men who have to do their work in a standing position.

Gas-Electric Motor Cars—St. Louis Southwestern Rwy.

The gas-electric motor cars, eight in number, recently ordered from the General Electric Company have been received and are being put in service. The details of construction conform in general to the standard cars. They are 70 ft. 1¾ in. over bumpers and 10 ft. 6⅜ in. wide overall. The weight is approximately 49 tons.

The Grand Trunk Pacific is completing station buildings at the rate of one each week, 20 having been erected recently on the main line of trans-continental in British Columbia.

Twenty-second Annual Convention of the Traveling Engineers' Association

The Traveling Engineers' Association met in the 22nd annual convention at Chicago, on September 15. It was the largest meeting held by the organization and the proceedings were unusually interesting. After the usual preliminary functions President Roesch said:

"Those of you who have kept in touch with the various articles appearing from time to time in the railway technical press have no doubt noticed that our conventions are always spoken of as the livest, best attended and hardest working of the many gatherings of railroad men who annually get together to forward the interests of the companies they represent. The credit for this is due almost wholly to you men on the floor. I therefore trust that by your prompt and regular attendance, your full and animated discussions, you will in this convention sustain the reputation achieved in the past.

"Since last we met several events of serious import have transpired, all unforeseen at that time, but all having material influence upon our present condition. I refer now to the war in Europe, the threatened railway strike in this country and the tentative settlement of the Eastern railway rate case. Of these the final outcome of the first is as yet problematic. The second is in the process of settlement by arbitration. The influence of the third, however, is now with us and demands our serious consideration. The decision in the Eastern rate case is no doubt a sore disappointment to the managements of the railways concerned. Under our form of government, however, it was about what was to have been expected. While a few slight increases were granted outright the commission seemed to infer that the railroads could more readily increase their earnings by indicated operative economies than by an arbitrary increase in rates. As a matter of fact, the railroads have for years been working along the principal lines suggested by the commission and while the results have been encouraging they have not by any means been so easy of achievement nor as remunerative as the commission appears to think possible. Be that as it may, the only recourse left to us is to make the best of it and try by every means in our power to carry out such of the recommendations as come within our province. In our own particular field of work we are primarily interested in the problem of transportation and the efficiency of the machines handling it. We find in late years that the railroads have adopted every known mechanical appliance that increases the efficiency of the locomotive and at the same time has a tendency to decrease cost of operation, but regardless of the increased efficiency of the machine in the final analysis we arrive at the old, basic principle that the performance of the machine depends upon the men operating it. Therefore it is to the man behind the gun that I wish to direct your attention.

Understand me, this is no reflection on our present day enginemen, than whom no better class exists in any country, but as conditions are rapidly changing men must change or be changed to meet the new conditions. This means more and closer supervision and a higher degree of initial training. I believe the time is at hand when our methods must be changed; that in employing the new men to fill the ranks hereafter more attention must be paid to their mental than to their physical qualifications, and before any new men are placed in service they should be thoroughly grounded in the principles and manipulation of such appliances as come within their line of work, so that on their initial trip they can in return for a journeyman's wage render approximately a journeyman's product. Under the conditions prevailing on the majority of American railroads to-day it takes fully one year before the average student becomes what might be termed a fairly good all round fireman. This being the case, it must follow that during his probationary period or learning time his work represents a distinct loss to the company as compared with that of the experienced man.

The same may be said to be true in a measure of many of our newly promoted engineers. Therefore, if the aspiring student be given a thorough preliminary training before he is ever placed in service and this training be then continued throughout his firing period with a view of fitting him for the position of engineer, there is no question but that the losses incidental to the student period, that is, the third year's service, in either capacity, could be almost wholly eliminated. With the increase in size of the modern locomotive and train and the refinement of operation made necessary, the losses due to unskillful handling are being rapidly increased and multiplied. These losses we wish to avoid by correct training. Several railroads have already a practically similar plan in effect and it is only necessary to cite attention to some of them, as, for instance, the Erie, to show what supervision and training can accomplish toward a reduction in expense.

You have no doubt noticed that most of the items as suggested by the commission, if carried out, would involve some increase in initial expense, and the plan here outlined would in the beginning result in increased costs due to increase in supervision. It may, therefore, be a rather difficult matter to induce some of our managements to increase present expenses on the promise of future economy, but to my mind this is the only solution of this particular problem, namely, if we wish to increase the efficiency of the service we must first increase the efficiency of the men performing that service. This I believe is the longest step that we can take toward carrying out the recommendations of the commission.

Another item whereby some saving may be effected is to have enginemen inspect for and report such defects as come under the rules of the boiler inspection and safety appliance bureaus. This would entail no extra work on the part of the enginemen and might at some time avoid a violation of the law, or at least an expensive delay. While we all have terminal inspectors, yet two inspectors are better than one, and as the enginemen have these things constantly before them and are primarily interested in their upkeep, they are in better position to note defects than any terminal inspector, especially at such points as small terminals where the inspector's duties are so divided that he can not always have access to a locomotive under steam or under conditions when steam leaks are manifest.

Before calling attention to the various papers and reports of committees to come before us, I wish to say to all, but more especially to the younger or newer members, that the floor is open and I trust that you will take advantage of the opportunity offered. We come here to learn by the exchange of ideas. Therefore, if you have any information to impart, let us have it. If you have no information for others you must be seeking it, so ask questions. You have all had an opportunity to read and digest the various committee reports and have no doubt noted that they have been well and ably handled. Any points that you desire to go into further can be brought out in the discussion on the floor.

After the dispatch of routine business, the first subject taken up for discussion was:

Difficulties accompanying the prevention of dense black smoke and its relation to cost of fuel and repairs.

The committee handling this important subject were Martin Whelan, chairman; assisted by Messrs. A. M. Bickel, P. K. Sullivan, W. A. Heath and B. J. Feeny.

The principal parts of the report read:

The question of smoke elimination is a very old one, in fact should naturally have died of old age long ago, but instead it is becoming a more important and leading question every year and there is no doubt but that it will continue so until such time as the nuisance is abated. It has been a leading question in Europe for years and still continues to be one.

At the last meeting of the International Association for the Prevention of Smoke, held at Pittsburgh, the Smoke Abatement League of Great Britain was represented by William F. Smith, of Glasgow, Scotland, who delivered an address entitled "The Abatement of Smoke on Two Continents." A committee of three, namely, Mr. Roberts, of Cleveland; Mr. Viall, of Chicago, and Mr. Searles, of Pittsburgh, were appointed to work with Mr. Smith, of the British league. All three of these men were connected with the city smoke departments of their respective cities. Mr. Smith stated: "The principal object of my coming across to the convention is to represent a committee formed at a very large smoke abatement conference in London two years ago. There were represented over two hundred municipalities. They had three from the States, two from Germany, one or two from France and over two hundred from the municipalities of Great Britain."

In reading over the proceedings of the London conference referred to, it is evident that the difficulties met with there are identical with ours. They, like ourselves, have no desire to carry the problem of smoke elimination to a point where it will cripple their industries or drive them from the cities where they have located, as they recognize the fact that these industries have made the cities what they are. They also recognize the fact that the burning of bituminous coal is the principal cause of the so-called "smoke nuisance," and they wish to continue its use in order not to injure the coal mining industry in their own country. One of the difficulties is the lack of knowledge of the fundamental principles of combustion by those who use the coal. Schools, supported by the State, for the education of the firemen were advocated by several speakers at the London conference. Germany has schools for this purpose. This phase of the problem has received very little or no consideration in this country, but it is a fair question to ask: "Why shouldn't it?"

Bituminous coal, being the fuel in general use on locomotives, and on account of being high in volatile matter is the cause of nearly all smoke agitation, will be the only fuel considered in this paper. In order to eliminate dense black smoke, three conditions must exist, viz., to supply the fire with sufficient air, to thoroughly mix the combustible gases and air, and to maintain the temperature in the fire-box to cause the combustible gases and oxygen of the air to unite. In stationary practice this is much easier to accomplish than in a locomotive, because it is possible to obtain a much longer travel for the gases by proper furnace construction before the gases come in contact with the boiler sheet which has a cooling effect on them. The design of a locomotive boiler is restricted, whereas the design of a stationary boiler is seldom restricted in either length, width or height. The stationary plant can apply any kind of a stoker. On the other hand, there is not one of these stokers that can be applied to a locomotive. In stationary practice natural draft is generally used on account of the much lower rate of combustion, while on a locomotive, on account of the higher rate of combustion, it is necessary to use forced draft at all times. Even when the throttle is closed, it is necessary to use the blower on account of draft restrictions in the smokebox and lack of height to the stack. Experiments to obtain perfect combustion have been tried more extensively in stationary than in locomotive practice, not because locomotive men do not appreciate the value of these experiments, but because of the ease with which they may be conducted on stationary plants as compared with locomotives. It is found that inadequate draft is usually responsible for smoky chimneys; therefore it is evident that it is necessary to have a properly designed front end, including the exhaust nozzle, ample grate opening and ash-pan opening large enough to insure free access of air.

On account of their intimate relation we might consider together the second and third requirements, namely, to thoroughly mix the combustible gases and the air, and to maintain the temperature in the fire-box to cause the combustible gases and the oxygen of the air to unite. We might say without going into the chemistry of combustion that this is a difficult problem, first, on account of locomotives generally being hand-fired there is an excess amount of air required to obtain the necessary oxygen to mix with the volatile that is given off from the coal immediately after it is placed on the fire. Therefore the smaller the amounts of coal fired at a time, the better the result obtained. If heavy charges of coal are applied, there will not be sufficient air to mix with the volatile and the temperature of the fire will be materially reduced.

The brick arch is a great aid in smoke elimination, as it increases the travel of the gases and gives them a chance to combine with the oxygen of the air before coming in contact with the comparatively cool fire-box sheets; therefore, the absence of the arch makes it more difficult to eliminate smoke. When fresh coal is applied, the steam jets, beside giving a small mixing effect, are helpful in furnishing the necessary air over the fire. They require the constant attention of the fireman, because if they are not closed after the volatile is burned off they will inject a surplus of cold air which will have a tendency to reduce the temperature in the firebox.

Special effort should be made to furnish a uniform grade of coal because it is hard for the best fireman to obtain the best results with a grade of coal which is continually changing. Better results will be obtained if an inferior grade of coal is furnished at all times, because where it is changed frequently the locomotive is drafted to burn the inferior grade and the better grade is wasted. In regard to the relative cost of fuel in connection with smoke elimination, it has been proved beyond questionable doubt in stationary practice that where plants have been remodeled to overcome smoke a saving in fuel and increased efficiency has resulted. In locomotive practice the same results have been obtained where the smoke-preventing devices have been judiciously used, but to obtain these results constant watchfulness is necessary.

The question was asked "Why do railroads in this country fail to control the smoke problem as they do in European countries?" Some rather far-fetched answers were given when the real answer is greater care in firing.

Considerable information was given about briquettes and other forms of fuel used abroad, but it is of no consequence to our railroad companies. The report says that the use of briquettes is a large factor in the elimination of smoke on European railways, but we do not believe that to be true.

Faithfulness.

The diamond is known as one kind of crystal and coal as another. But, on the whole, though the diamond is beautiful, the world would rather give up its diamonds than its coal. More depends upon the coal—far more. Genius is as shining as the diamond; faithfulness to duty is often as dull as the coal to the eye. But it is the latter, after all, that helps the world most.

For Instance.

Mrs. Brown was said to say: "Our language is full of misnomers. For instance, I met a man once who was a perfect bear, and they called him a civil engineer." Mrs. Smith—"Yes, but that's not so ridiculous as the man they call a teller in a bank. He won't tell you anything. I asked one the other day how much money my husband had on deposit, and he just laughed at me."

Pacifics and Mikados for the New Orleans and Northeastern

In order to obtain the greatest economy in the maintenance of railway motive power, locomotives of different classes should, as far as practicable, be equipped with interchangeable detail parts. This can frequently be done in the case of the majority of parts subject to wear, even in locomotives which differ widely in type. By such a method of construction a minimum number of patterns and stock parts need be carried for renewals.

The Baldwin Locomotive Works has recently completed, for the New Orleans and Northwestern railroad, five Pacific and three Mikado type locomotives in which this method of construction is carried out to an unusual extent. With these two types it is a comparatively simple matter to arrange the wheel bases so that interchangeable boilers can be employed; and by using driving wheels of suitable diameters, duplicate cylinders can be applied and a proper ratio of adhesion maintained in both types. The following is a partial list of the interchangeable details used on the New Orleans and Northwestern locomotives:

Boilers and accessories, cylinders, cylinder and steam chest heads, cross-heads, pistons and rods, piston valves, driving-boxes, back engine trucks, including wheels and axles, cabs, foot-plates, pilots and the greater part of the furniture and smaller details.

The boilers are of the straight-top type, equipped with the Gaines locomotive furnace. The combustion chamber is used in combination with an arch supported on water-tubes. The fittings include a power-operated fire-door and grate-shaker. The superheater is composed of 24 elements, and provides a superheating surface of 504 square feet.

The piston valves are 13 inches in diameter; they are driven by Walschaerts motion, and are set with a lead of 1/4 inch. The frames and spring rigging are of simple strength, designed for heavy service. The rear truck is of the improved Hodges type, so arranged as to give a maximum amount of clearance under the ash pan.

The frames, driving-axles and engine truck axles are of steel with vanadium content. In the case of the Pacific type locomotives, the main and side rods are also of this material. All the rods are rectangular in section.

The tenders of both types are closely similar in construction, and are fitted with a vestibule connection at the rear end.

These locomotives are built to operate on 75-pound rails. The grades and curves on this road are generally light, the steepest grades on the main line being of one per cent., and the sharpest curves of 6 degrees radius.

The following are the leading dimensions of both types of locomotives:

PACIFIC TYPE.

Gauge—4 ft. 8½ ins.

Cylinders—22x28 ins.

Valves—Piston, 13 ins. diam.

Boiler—Type, straight; diameter, 66 ins.; thickness of sheets, 23/32 in. and ¾ in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox* — Material, steel; length, 110 3/16 ins.; width, 76 ins.; depth, front 67¼ ins., back 59½ ins.; thickness of sheets, sides 5/16 in., back 5/16 in., crown ⅜ in., tube ½ in.

Water space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Material, steel; diameter, 5⅜ and 2 ins.; thickness, 5⅜ ins. No. 9 W. G.; 2 ins. No. 11 W. G.; number, 5⅜ ins. 24, 2 ins. 172; length, 19 ft. 3 ins.

Heating surface—Firebox, 171 sq. ft.; tubes, 2,373 sq. ft.; Fire-brick tubes, 29 sq. ft.; total, 2,573 sq. ft.; grate area, 46 sq. ft.

Driving wheels—Diameter, outside 68 ins., center 60 ins.; journals, main 9½x11 ins., others 9x11 ins.

Engine truck wheels—Diameter, front, 33 ins.; journals, 6½x11 ins. diameter, back, 40 ins.; journals, 7½x12 ins.

Wheel base—Driving, 12 ft.; rigid, 12 ft.; total engine, 32 ft. 11 ins.; total engine and tender, 67 ft.

Weight—On driving wheels, 130,500 lbs.; on truck, front, 43,800 lbs.; on truck, back, 32,400 lbs.; total engine, 206,700 lbs.; total engine and tender, about 352,000 lbs.

Tender—Wheels, number 8, diameter 46 ins.; journals, 5½x10 ins.; tank capacity, 7,500 gals.; fuel capacity, 14 tons; service, passenger.

Locomotive equipped with Schmidt superheater.

Superheating surface, 546 sq. ft.

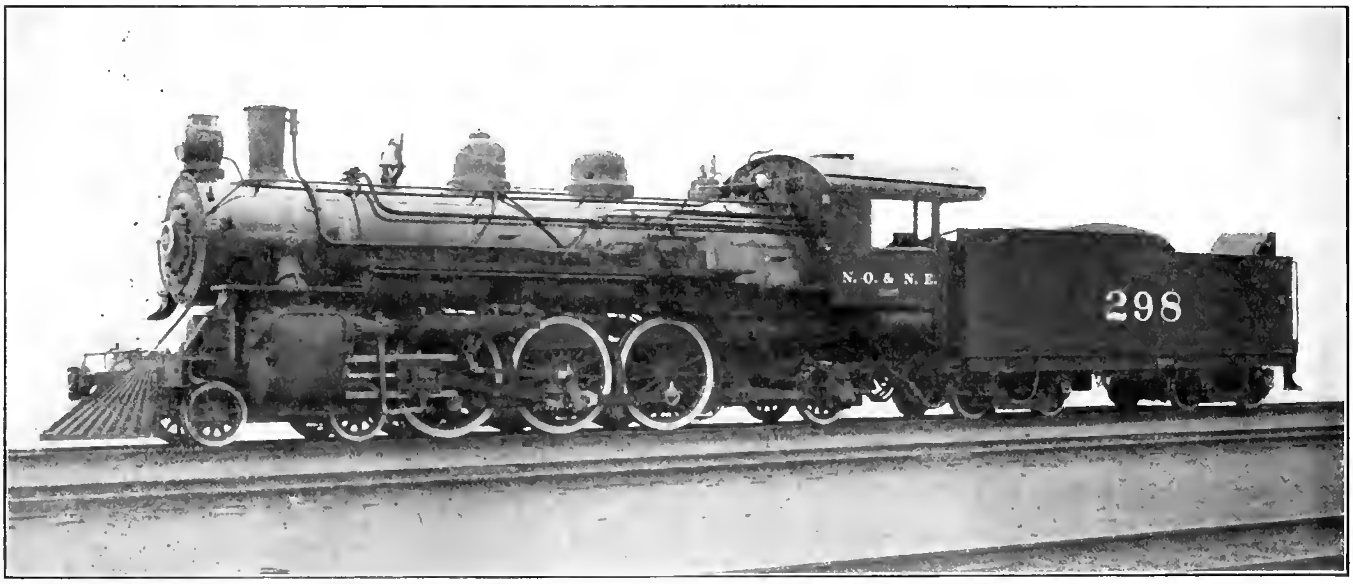
*Gaines locomotive furnace. Length of grate, 87 ins.

MIKADO TYPE.

Gauge—4 ft. 8½ ins.; cylinders, 22x28 ins.; valves, piston, 13 ins. diam.

Boiler—Type, straight; diameter, 66 ins.; thickness of sheets, 23/32 and ¾ in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox* — Material, steel; length, 110 3/16 ins.; width, 76 ins.; depth, front 67¼ ins., back 59½ ins.; thickness of sheets, sides 5/16 in., back 5/16 in., crown ⅜ in., tube ½ in.



PACIFIC 4-6-2 TYPE LOCOMOTIVES FOR THE NEW ORLEANS AND NORTHEASTERN RAILROAD.
C. Phillips, Master Mechanic. Baldwin Locomotive Works, Builders.

Water space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Material steel; diameter, 5⅜ and 2 ins.; thickness, 5⅜ ins. No. 9 W. G., 2 ins. No. 11 W. G.; number, 5⅜ ins. 24, 2 ins. 172; length, 19 ft. 3 ins.

Heating surface—Firebox 171 sq. ft.; tubes, 2,373 sq. ft.; fire-brick tubes, 29 sq. ft.; total, 2,573 sq. ft.; grate area, 40 sq. ft.

Driving wheels—Diameter, outside 57 ins., center 50 ins.; journals, main 9½x11 ins., others 9x11 ins.

Engine truck wheels—Diameter, front 33 ins.; journals, 5½x10 ins.; diameter, back, 40 ins.; journals, 7½x12 ins.

Wheel base—Driving, 15 ft.; rigid, 15 ft.; total engine, 33 ft. 6 ins.; total engine and tender, 67 ft. 7 ins.

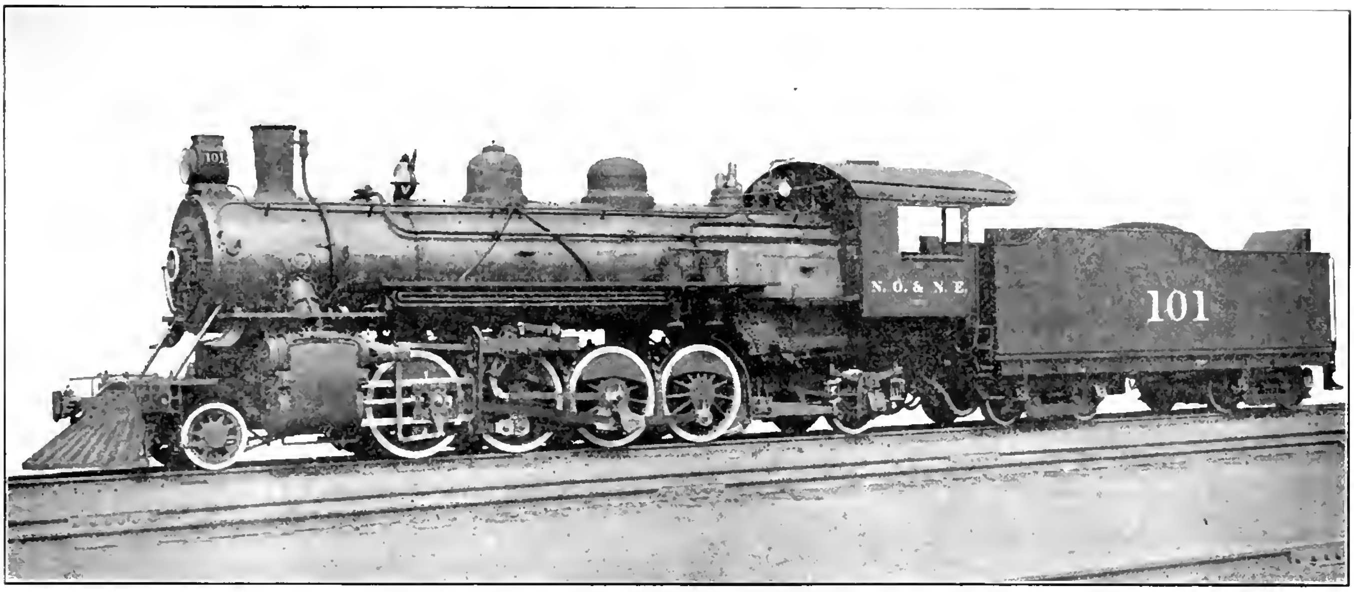
Weight—On driving wheels, 160,000 lbs.; on truck, front 19,700 lbs., back 29,800 lbs.; total engine, 209,500 lbs.; total engine and tender, about 355,000 lbs.

Tender—Wheels, number 8, diameter 36 ins.; journals, 5½x10 ins.; tank capacity, 7,500 gals.; fuel capacity, 14 tons; service, freight.

Locomotive equipped with Schmidt superheater.

Superheating surface, 540 sq. ft.

*Gaines locomotive furnace. Length of grate, 87 ins.



MIKADO, 2-8-2 TYPE LOCOMOTIVES FOR THE NEW ORLEANS AND NORTHEASTERN RAILROAD.

C. Phillips, Master Mechanic. Baldwin Locomotive Works, Builders.

Invention of the Interchangeable System.

In many technical books of reference published in this country we are told that standard gauges and the system of interchangeability of parts was introduced by an Englishman about 1840. Although it is not so well known as it ought to be among American workmen, this country originated the interchangeable system, and did more than all other countries combined to popularize standard dimentions.

To Eli Whitney, inventor of the cotton gin, belongs the credit of introducing interchangeable parts of small tools. In 1898 Whitney organized in Connecticut an establishment for the manufacture of small arms, and had all parts made on the interchangeable system. He used temperate and hardened jigs, the size being arranged upon the recognized standards, the inch being the basis of measurements. This system appealed to the leading mechanics of the United States, and quickly attained popularity. When the United States military authorities decided to establish an up-to-date armory at Springfield, Mass., Whitney was employed to arrange the methods of production.

In 1855 the British Government got machinery from the Springfield armory to enable them to introduce the American interchangeable system in making firearms, and many other establishments in different countries of Europe ordered tools for introducing our interchangeable system in different lines of mechanical industry.

The manufacture of clocks, for which Connecticut became famous, was greatly promoted by the introduction of Whitney's system, and the same help was employed later in the manufacture of sewing machines.

Interest in the Locomotive Among Americans.

It is curious to observe how interested all classes of American railroad men are in anything relating to the locomotive. This feeling of interest is not confined to those immediately connected with the machinery department, where talking shop naturally finds the locomotive a fertile subject of conservation. From the verdant brakeman beginning to run on "extras" to the veteran manager or president, all the men and officials pride themselves on knowing something not altogether elementary about the locomotive. The locomotive stands out a conspicuous figure in railroad operating, and the intelligent portion of the employes try to comprehend the principles of its operation. Not a few railroad men outside of train service have a correct idea of the leading dimensions of the principal locomotives belonging to the company that employs them.

Another curious thing about this tendency of American railroad men is that the interest in locomotives is not shared by the railway men abroad. The writer once asked the guard of an express train abroad what kind of engine was pulling the train, and he expressed supreme indifference. Was it compound? He knew not!

Electrical Industry.

Every ambitious young mechanic ought to study electricty sufficiently to be able to take a hand in the construction or repair of electrical machinery. One of the most effectual aids that we have seen lately for a young man cherishing the ambition to make himself an electrician is a small book called, "The Young Man and the Electrical Industry," published by the Westinghouse Electric Company, East Pittsburgh. Any person interested can receive a copy of this valuable booklet free on application to the above address.

We have on our desk a copy of our Railroad Men's Catechism printed in Chinese characters. It appears to be well printed, free from typographical errors and we have no doubt is read with pleasure and profit by the trainmen of the Celestial Empire.

General Foremen's Department

What Every Apprentice Should Know

We have repeatedly commented upon the success achieved by Mr. H. E. Blackburn, instructor of apprentices of the Erie Railroad at Dunmore, Pa., and we now have pleasure in reproducing from the Erie Railroad Employees' Magazine an article contributed by Mr. Blackburn as follows:

The lever is a rod or bar in any shape, which is free to turn about on a fixed point or support, called a Fulcrum.

The lever in operation is a force used at any point on the bar, that may make a pressure, or a pull at another point, using the fulcrum as a support; in other words, the weight at any side multiplied by the arm distance from the fulcrum is called the Moment of Force. If the other end of the lever has force enough applied to its length, it should equal the moments on the weight end of the lever.

Two boys of different weights soon learn that the heavy boy is allowed the short end of the "See Saw" board, if they are to balanace one another over a log, or the fulcrum point. If an apprentice wishes to lift an iron block so he can get a roller under it and the block weighs 270 pounds, and he uses a bar 12 feet long and places a block 3 feet from the block under the bar, it will take but 90 pounds of force on the long arm of the lever to raise 270 pounds on the short end, for

$$\frac{\text{Weight x Short Distance—Force}}{\text{Long Distance}}$$

Levers are divided into three kinds, according to the position of the loads, or weights they raise; in other words, the force, with its distance, must equal the weight and its distance from the fulcrum.

A lever of the first kind is found in the use of an ordinary pinch, or crowbar. A lever of the second kind is found in the throttle valve handle of a locomotive, and a lever of the third kind is well shown by the old-style safety valve lever, with a weight hung on the end.

$$\frac{\text{Weight x Short Distance—Force}}{\text{Long Distance}}$$

$$\frac{\text{Force x Long Distance—Weight}}{\text{Short Distance}}$$

$$\frac{\text{Weight x Short Distance—Long Distance}}{\text{Force}}$$

$$\frac{\text{Force x Long Distance—Short Distance}}{\text{Weight}}$$

The Pulley Block (block and fall) is really a rotary form of the lever, which is used to reduce its valve of force in lifting a weight; this is done by a set of grooved wheels, sometimes called "Sheaves," over which is placed as a means of transmission a rope or chain.

If a grooved pulley is fastened by a hanger to the roof of a building and two 50-pound weights are suspended at the ends of a rope, thrown over the pulley, the two weights will balance one another over what is called a Fixed Pulley.

If a grooved pulley is slung in the loop of rope, so as to lift a 50-pound weight, and one end of the rope is fastened to the roof, while 25 pounds of force is applied to the other end at the roof from a skylight, why, the 25 pounds of force will lift the 50 pounds of weight on what is called the Movable Pulley.

If a fixed and a movable pulley is now worked together by the use of a rope, or chain, it can easily be seen that for every movable pulley added to a fixed pulley the weight will be lifted that much, or part easier, so that with a 3-pulley block one man can lift many times his own weight.

A gear is nothing more than a pulley-wheel that has teeth on it, and, consequently, a lever of the first kind.

Two gears running together are called a train of gears. The intermediate gear between the driver and the driven is called the Follower.

Two gears, with a follower between, are called Simple Gearing, while four gears, with two coupled up as a follower, are called Compound Gearing, when applied to other machines where varied lead is required in thread, or spiral work.

When the teeth on a gear turn in the direction of the hands on a clock, the motion is called Clock-wise; if in the opposite direction, Counter-clock-wise.

If the driver wheel is larger than the driven, the driven will revolve the fastest. If the driver has 60 teeth and the driven 120 teeth, the ratio is 2 to 1. If the reverse, 1 to 2.

Gear teeth are only used where slow speed and great power is required. Belts are always used where high speed and light work is done. Of course, the direct motor-drive is an exception.

If it takes one minute to drag 14,200 pounds of iron over a distance 25 feet on the ground, with 0.18 pounds allowance for friction, why, the horsepower required to do the work would be

$$\frac{0.18 \times 14200 \times 25}{33.000} \text{ or 1.94 horsepower}$$

If you wish to slide a weight of 1,000 pounds up a plank that is 3 feet long, and one end of the plank is raised 2 feet, like shoving a car up on the coal pockets, why, the force required would be (no friction allowed),

2/3 of 1,000, or 667 pounds of force.

This is called the Inclined Plain. It is really nothing but the wedge under another name.

$$\frac{\text{Weight x Height x Friction}}{\text{Length of Plane}} \text{ Force required}$$

$$\frac{\text{Force Length}}{\text{Height}} \text{ Weight required}$$

The principle of the wedge is shown at work by the chisel, or the screw-thread. The latter is nothing more than a wedge bent into a circular form.

After lining up some piece of machinery, the print may call for some certain speed that is required, in order to run it properly, and there are four long rules given in most books in figuring pulley speeds, when all you have to do is to divide by the diam. or the revolution of the pulley wanted, and multiply this by the other two sizes; for instance, if the speed of the driver is 120-R. P. M., in the diam. of the driver is 30 inches; if the diam. of the driver is 8 inches, what is the speed of the driver? Using the pulley to divide by, or the question asked about the driver 8.

$$\frac{120 \times 30\text{—450-R. P. M. of the driver}}{8}$$

If the speed of the driver is 120-R. P. M.

If the diam. of the driver is 30-R. P. M.

If the speed of the driver is 450-R. P. M.

To find the diam. of the driver?

Using the pulley to divide by, or the question asked about the driver—450.

$$\frac{120 \times 30\text{—8 inch. diam. of driver}}{450}$$

If you have more than one set of pulleys, figure out the first set; take the results and figure out the next pulley, and so on until you arrive at the point desired.

Mr. Blackburn gives the above advice particularly to apprentices, but the information given will profit every mechanic no matter how long he has passed the apprenticeship period. Every ambitious mechanic will find familiarity with knowledge helpful in raising him from the common workman condition.

Important Improvement in By-Pass and Drifting Valves

An important addition to locomotive appliances in regard to the perfecting of by-pass valves and drifting valves has

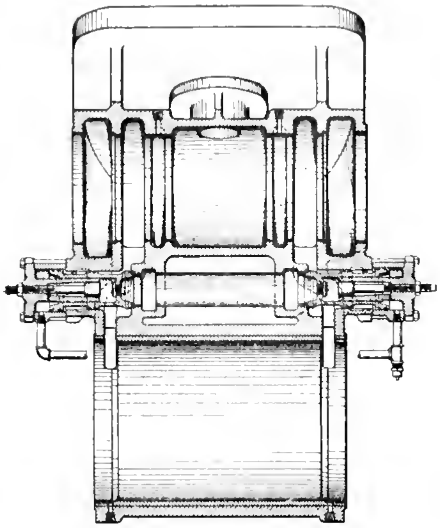


FIG. 1.

been jointly invented by Mr. H. C. Manchester, Superintendent of Motor Power and engineer of the Lackawanna, and Mr. S. S. Riegel, Mechanical Engineer of the same road. As shown in the accompanying illustrations Fig. 1 is a vertical section through a locomotive engine cylinder and steam chest, Fig. 2 a central section of one of the improved valve mechanisms, and Fig. 3 a side elevation of the engine cylinder and valve mechanism, showing the pipe connections. The invention has for its principal object to provide an improved valve mechanism for automatically opening communication through a by-pass valve between the opposite ends of the engine cylinder when the locomotive is drifting, or running when the throttle is closed, thereby permitting free passage of the contents of the cylinder from one end to the other, and maintaining the piston substantially balanced as to pressure upon its opposite sides in all positions.

Another important feature is means for

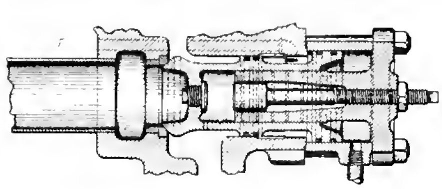


FIG. 2.

admitting a limited quantity of steam at the same time that the by-pass is open, and so prevent the formation of a vacuum in the cylinder, also assisting in the lubrication, eliminating the carbonization of oil besides preventing the chilling of the cylinder walls by the entrance of cold air. The valve used is of the differential hollow piston type, subject to the opposing pressures of the engine valve steam chest, and when the throttle is open the pressure from the steam chest holds the by-pass valve in the closed position, but when the throttle is closed, and the pressure from the steam chest falls, the opposing boiler pressure opens the by-pass valve, and admits a limited quantity of live steam into the cylinders. It will be readily noted that when the locomotive is running the steam admitted through the throttle to the steam chest also passes through the central pipe, as shown in Fig. 3, and acting on the larger annular area of piston head holds the valve closed upon its seat. When the throttle is closed the pressure on this end of the valve is removed, but the boiler pressure still continuing to act on the other face of the differential piston, and the valve is moved away from its seat and opens the by-pass between the opposite ends of the cylinder, thereby balancing the pressures

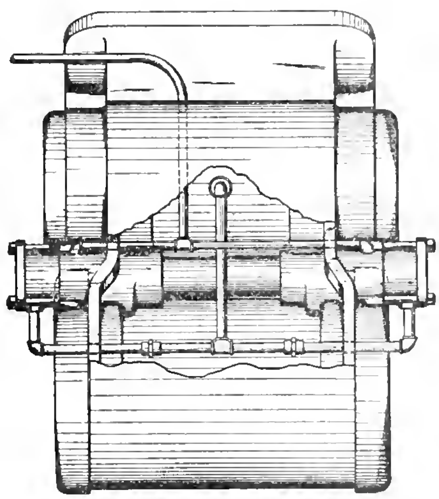


FIG. 3.

on each side of the piston. Means are used for controlling and limiting the travel of the valve.

This appliance is automatic in its action and needs no attention whatever from the engineer, and has been in operation on about 30 locomotives, some of them having the appliance for nearly two years, and its success has been in every respect complete.

Structural modifications have been provided so that the appliance may be adapted to any existing type of locomotive, and separate devices have been perfected and successfully applied to the more complex types of locomotives. Figs. 4 and 5 illustrate a new type of drifting-valve for locomotive engines which is of a simple construction and controls the supply of a limited quantity of steam to the valve chest and cylinders when drifting, or running with throttle closed, and acting automatically under the opposing pressures of the valve chest or cylinder and the live steam from the boiler. Fig. 4 is a central section of one form of valve, and Fig. 5 showing a structural modification. They both comprise a casing having connections adapted

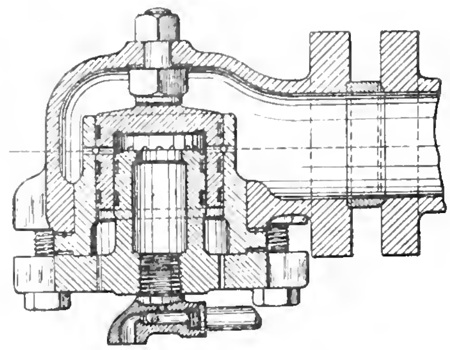


FIG. 4.

to communicate respectively with the valve chest or engine cylinders, and a live steam supply from the boilers, and containing a valve subject on one side to the pressure from the valve chest tending to close the same, and on the opposite side to live steam pressure tending to open the valve, a portion of its area being exposed to the atmosphere. As shown in Fig. 5, if it be desired to vary the maximum degree of pressure, which may be admitted through the valve device, or in other words, to adjust the degree of pressure at which the valve will automatically close, a spring may be employed acting between the top of the valve and an adjustable screw plug mounted in the casing and having a lock nut. This spring assists the steam pressure in closing the valve, and by adjusting the screw plug the maximum degree

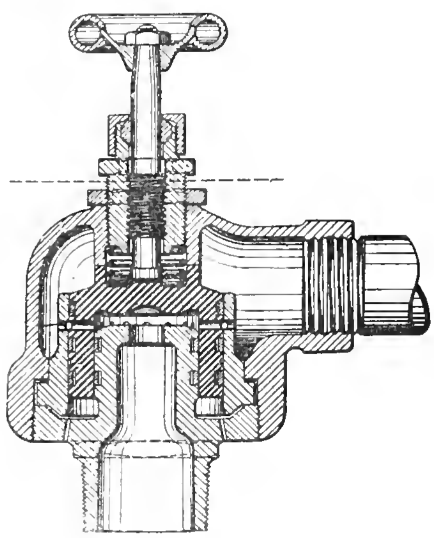


FIG. 5.

of pressure through the valve device may be limited to any desired safe degree.

If it should be desired to positively

close the valve at any time a threaded stem may be mounted on the plug, and be provided with a handle outside the casing, whereby the same may be screwed down and hold the valve closed tightly upon its seat, the faces being finished to provide a seat for the same. A drain valve, as shown in Fig. 4, may also be applied, if desired, for draining out water of condensation when steam is shut off from the pipe.

Both of these devices have thus a common function in that they admit live steam under automatic control in the steam cylinder passages, or directly with the cylinders to break up the vacuum during periods of coasting. The plain drifting valve, latterly described, is applicable in place of ordinary steam chest relief valve on either saturated or superheated engines, on slide or piston valve cylinders of present construction engines, which are not ordinarily equipped with by-pass valve chambers.

The by-pass valve, first described, has a double function, that is, the admission of live steam into the cylinder passages during period of coasting, and the by-pass of contents of the cylinders, from one end to the other during similar periods. The valves may be linked together by usage on a Mallet type engine, which is normally equipped with both type cylinders, in which case the drifting valve would be applied to the slide valve cylinders, and the by-pass valve to the piston valve cylinders.

Smoke Still in Evidence.

The agitation in favor of smoke prevention is likely to continue as long as bitimunous coal burning furnaces send forth the black products of combustion that testify to inferior firing or badly arranged furnaces. It took a long time to impress upon the American public that smoke was not a necessary evil, but they are now making up for that tardiness. Nearly every town in the country has officials whose duty it is to prosecute those who contaminate the air with smoke, and most of them are rigidly enforcing the laws.

The formation of smoke is a matter of air supply and furnace temperature. This may be taken as certain, although the details of the various processes are not yet clearly determined. The formation of smoke occurs during the volatization of the hydro-carbon gases. As these come off the coal, if the air supply is sufficient and at the same time the surrounding temperature is high enough to allow combustion taking place, the gases will burn with a bright flame, steam and carbon dioxide being formed in the process. If, however, the air supply is deficient; or, the air being plentiful, the flames penetrate to portions of the flues that are below the necessary temperature, a recondensation of the gases takes place, and the carbon becomes separated out in a finely divided condition and smoke is formed.

Another cause given for the formation of smoke is that the high temperature of the furnace gases causes a dissolution of the constituents of the hydro-carbon, which, if the supply of oxygen is deficient, results in unburnt hydrogen and unconsumed carbon in the form of smoke. The proper supply of oxygen in this case is of supreme importance. If the air supply is ample when the gases come together, the hydrogen and carbon will burn brightly, and no smoke will appear.

That is a short lesson on the chemistry of combustion which every fireman ought to study.

Western Railroads Desire Increase of Rates.

Officials representing the railways west of the Mississippi River have entered into communication with the Interstate Commerce Commission with a view to the submission to the commission for permission to make a general increase of freight rates. While not encouraged by the outcome of the eastern advance rate case, the western roads, it is understood, consider the present an opportune time for presenting petitions which will constitute the basis for another proceeding such as the one just concluded. Managers of the western lines are prepared to contend that they need more revenues to meet the increasing expenses of operations, and to point out that their lines are in even greater need of relief than the eastern lines because of necessarily longer hauls and less density of population. It is not the purpose of the roads to propose a horizontal advance in all rates, as was done by the eastern carriers. The proposed tariffs will be in the form of a scientific readjustment of both the class and commodity rate structures, the amount of the increase varying with the character of the shipments and the class of traffic. Preparation of the tariffs in that way will increase many rates and lower others. The general trend of the revision, however, will be upward. It appears probable that the proposed new schedules of rates may be filed with the commission just before October 1. The time of filing will depend, however, upon the ability of the carriers to get the tariffs into final form. The lines affected extend from the Mississippi River to the Rocky Mountain territory. The roads traversing the Pacific coast section may not be affected by the proposed changes.

It is to be hoped that the changes, whatever they may be, will not take so long a time on their consideration by the commission as in their previous efforts in this direction Time is money and the railroads need the money.

As Viewed by The Philistine.

A small-sized monthly called *The Philistine* comes regularly to our room. It is produced by Elbert Hubbard and says a good many things out of the common. We have received a marked copy of an article in which we are classed as a Trade Paper and are thus commented on:

And the Trade Paper is probably the most alive to the exigencies of education, and the gratification of the mental needs of its readers, than any other press production.

It asks, absorbs, gives.

Take up a Trade Paper; note the quality and texture of the paper, the clearness of the type, the beauty of its arrangement, the logic of its arguments, the well-expressed opinions of its contributors.

Then tell me if it isn't an education—beautiful, inspiring, strengthening.

Thousands of Trade Paper subscribers are receiving mental uplift and renewing their courage by its means.

The Trade Paper is the leader of the literary world.

It applies chiropractic methods to managerial meningitis, the numerical neuritis of the cashier, or the comatose businessman.

As a spinal adjuster the Trade Paper is a necessity. Without it there is great danger that the Glooms will get you.

It manipulates the dislocated vertebræ of declining business, until the spinal irritation walks its chalks, trundles its hoop, and you climb into your buzz-wagon again, and let 'er zip Gallagher!

The Trade Paper keeps the red corpuscles turkey-trotting and prevents pseudo-anginalitis or imitation heart-disease.

It helps you push your business, thereby obviating nerv. pros. For nervous prostration is never occasioned by you pushing your business; it only happens when your business pushes you. The subscriber.

It gives vivid character sketches of the passing great. It takes extensive tours over the fields of science, business and invention. It teaches by living, moving word-pictures the reasons for the failures and the causes of success.

Sarcasm and caricature turn many a trick.

The business of religion is now giving place to the religion of business; and the Trade Paper is the evangel of the true brotherhood of co-operation and self-respect.

Show me the company a man keeps and I will tell you what he is.

Show me a man who subscribes to and reads his Trade Paper and you will show me a man who will "show me" a man alive, alert, ambitious educated, successful. He has learned to ask, to seek and to find, and they that seek shall find, and to them that knock it shall be opened. These are the men we need.

Electrical Department

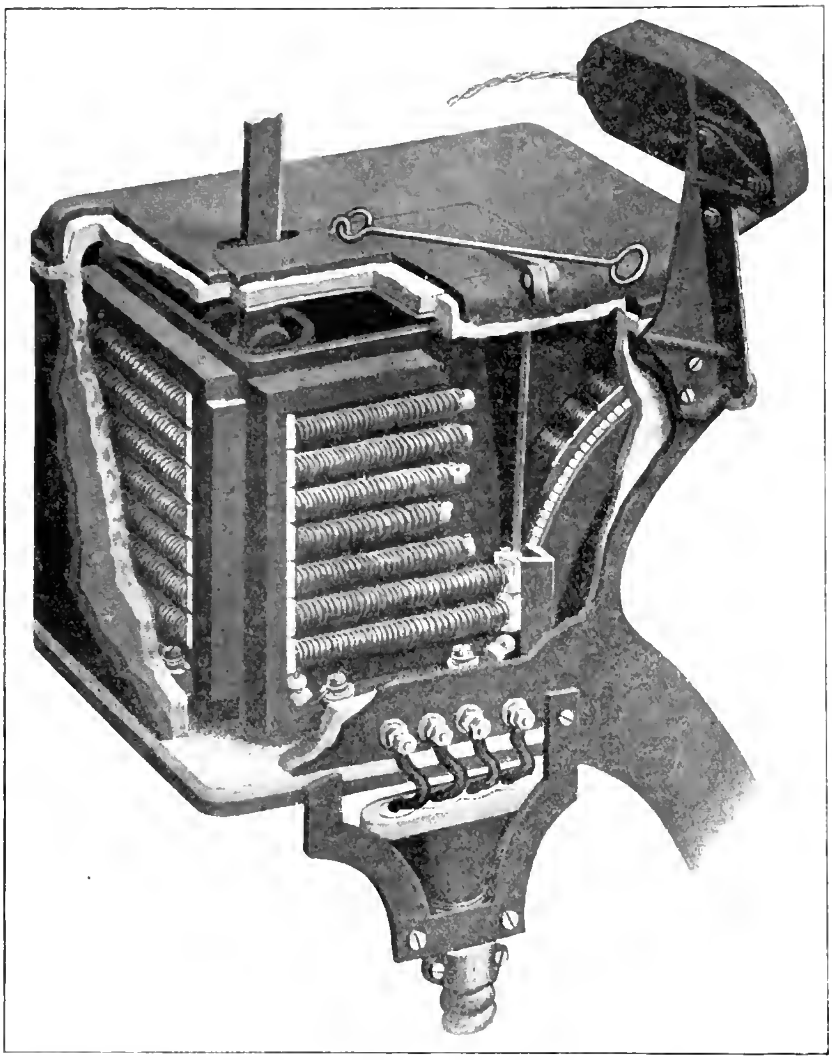
Electric Linotype Pots.

The linotype machine is one that composes and casts stereotyped words or lines for printing. Molten type metal is necessary, and until electricity was used the metal was heated and kept hot by gas, gasoline or kerosene. The use of these fuels cause heavy fumes in the composing rooms, and greatly reduce the efficiency of the operator. The use of electricity has solved the metal casting problem, for it not only eliminates the injurious gases, but has many other advantages, the most important of which is that absolutely uniform and evenly distributed heat is obtained.

The Westinghouse Company have one of these electric linotype pots on the market known as the "wicker type." Some of the many advantages gained by the use of this heater are as follows:

1. *Provides a perfect and automatic system of control.* The heat supply surrounds the entire exterior surface of the crucible containing the metal. Thus the whole mass of metal will reach an even temperature. The uniformity of temperature is further regulated by enclosing the metal crucible, and protecting same by heat insulation. The electric heat is controlled by a thermostat so that when once adjusted the temperature will remain automatically at a certain temperature.

2. *Eliminates "back squirts."* If the metal becomes too hot for proper moulding "back squirts" will occur, causing delay. Perfect slugs can only be obtained by metal at the proper temperature. The value of maintaining automatically a desired temperature cannot be overestimated, for it prevents porous and imperfect slugs, which are liable to break under the heavy pressure, thus necessity the knocking down and rebuilding of the form. If the metal is too low in temperature, it chills when flowing into the moulds, and an imperfect type face is the result.



CUT-AWAY VIEW OF WESTINGHOUSE WICKER-POT SHOWING ELECTRIC HEATING ELEMENTS.

3. *Uniform metal obtained.* The composition of the metal is important. Many of the linotype troubles are due to improper mixture caused by hot spots driving the antimony to the surface where it oxidizes. Excessive heat will also burn the tin which is used as the flux of the type metal, and an inferior metal is the result.

4. *Increases the efficiency.* The three factors that tend to lower the efficiency are: First, the time the machine is out of service; second, the time lost by the operator, and third, the time consumed by the machinist. With the elimination of back squirts and imperfect and porous slugs, maintaining perfect uniformity of metal, the maximum possible efficiency is attained.

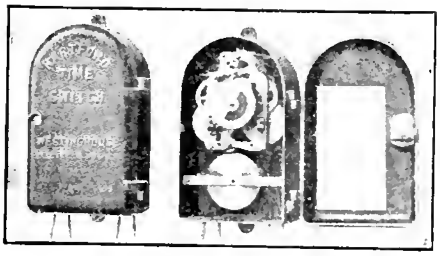
5. *Reduces the fire hazard.* There are no open flames and no highly combustible fuels.

6. *Can be heated ready for service in one hour.* From the time current is turned on to the time when the metal is at the proper casting temperature, approximately one hour is required. This time element is less than for any other method of heating, and is always positive and constant. This makes it possible to use automatic time switches, as shown in Fig. 2, the clock mechanism of which can be set for one hour previous to the arrival of the operator, when the current will be automatically turned on. The machine will then be ready for use when the operator arrives. This saves considerable time and expense where watchmen are not available, and in cold weather prevents the loss of the operator's time that is apt to occur where other forms of heating than electric are employed.

The time switch is furnished at a slight additional cost. It can be set to close or open the circuit at any time of the day or night. Thus, if the composing room force goes to work at 8 a. m. the time switch can be set to turn on the current at 6:30, and the metal will be ready for casting when the operators arrive.

In general form the Wicker-Type Pot is a modification of the standard gas pot,

the principal difference being its shape, which is rectangular instead of round. A cut-away view is shown by Fig. 1. The electrical heating units entirely surround the pot, and the asbestos lining is shown which prevents the heat from reaching the outside casting. The maximum amount of power consumed is 1,650 watts and the minimum 485 watts, the average consumption being about 800 watts. The maximum is used only when the temperature is below the proper working



TIME SWITCH FOR USE WITH WESTINGHOUSE WICKER TYPE POT.

point, and the minimum is used to maintain the working temperature, which it will do till cold metal is added to replenish the supply in the pot, or until the temperature is reduced by radiation that is slightly in excess of the amount of heat being supplied by the minimum current used.

The change from maximum to minimum or vice versa is effected by a magnetic switch operated by a thermostat placed in proximity to the mouthpiece of the pot, or at point of moulding. This thermostat acts to cut the current consumption from maximum to minimum when the right working temperature is reached, thus preventing too hot a temperature, and from minimum to maximum when it is necessary to prevent the temperature from running too low.

Electricity for Coal Hoisting.

The Saw Mill Run Coal Company, of Pittsburgh, Pa., has compiled some interesting operating data on its motor-driven coal barge unloading apparatus, and on the old steam driven equipment which was superseded by the electrical equipment. The data show the relative power and labor costs of the two systems under practically the same conditions.

With steam the coal and water costs to hoist on the average of nearly 8,000 tons of coal per month were $60 and $15 respectively. The electrical energy cost is about one cent per ton, which is slightly more than with steam. To offset this increase, however, the labor and maintenance expenses are reduced, and when the reliability of operation, together with the rapidity of unloading is considered, the electrical operation shows considerable advantage.

With electrical operation the licensed engineer at $125 per month can be replaced by a $75 a month man. There are very few repairs necessary on the electric motor, so that the maintenance is far below that with steam operation, as with the latter there is boiler and engine repairs.

The steam engine requires approximately 60 seconds to complete a cycle, and can not be speeded up, whereas the electric hoist can make a complete trip in 50 seconds, thus increasing by 20 per cent. the coal unloaded in a definite time. In tons of coal handled it means an increase of approximately 1,600 tons daily.

In changing over from steam to electric operation the only change made in the hoist was to remove the piston rods, bolt a ring gear to the crank disk and install a motor, the pinion meshing with the gear.

The Electric Motor for Drainage Pumping.

There is nothing uncommon in electrical pumping and much important work in the far west is being done in pumping water from the streams for farm irrigation. It is unusual to have a condition the converse of this, namely, the pumping of water away from the farms to save them from being inundated. Throughout the great Mississippi valley many thousands of acres of valuable lands at certain seasons of the year are so long under water that some can not be used for agricultural purposes. To overcome this it is necessary to build levees and then pump the water back to the stream.

The pumping is very irregular in amount, for the rainfall varies greatly from month to month, and again the head against which the pumping takes place varies, depending on the height of the river along the levees. There has been a number of steam plants operating in this service consisting of a simple engine connected to centrifugal pumps. The cost of such plants vary from $70 to $110 per horsepower, with a heavy charge for capital and upkeep.

Electrical pumping plants have shown excellent results. The cost per horsepower is not much more than one-half those of the steam plant, and there is in addition a considerable gain in fixed charges. A simple arrangement is provided for operation against different heads of water. The different heads require different speeds, and this is taken care of by using pumps with three gear ratios, secured by changing the pinions, so that the motors always work under advantageous conditions.

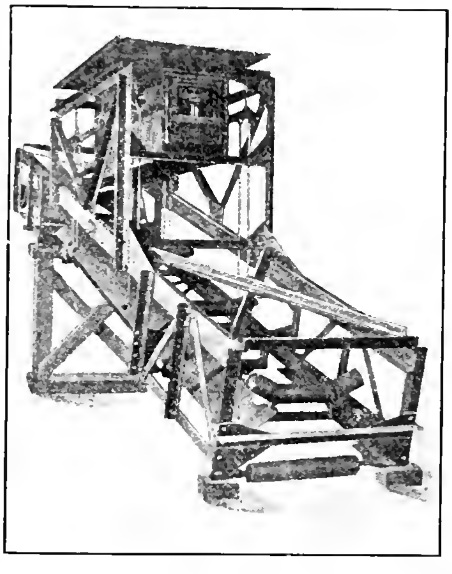
In figuring the necessary horsepower in motor capacity that is required 50 horsepower is used per 1,000 acres. Electric motor pumping thus enables small farms to take advantage of drainage, as the cost is small—whereas with a steam installation for a small farm the cost would be prohibitive.

Electric Conveyor Scales.

The illustration shows a scale for weighing bulk material in motion. A short section of the conveyor is suspended from scale beams mounted in a heavy steel frame. A corresponding length of the unloaded part of the conveyor is also suspended from the scale, but on the opposite side of the fulcrum from the loaded part so that its weight balances. In this way the tare weight is automatically deducted, and the scale is self-balancing.

The operation of this apparatus is based on the principle that the total weight passing a point in a unit of time is proportional to the product of the average weight of a unit length and the speed of motion.

The voltage of a dynamo is maintained proportional to the speed of motion, and the current is varied with the weight of the part of the conveyor suspended. The rheostat of the dynamo is controlled by scale beams of the lever and knife edge type. The counterpoise of the scale is a cylindrical plunger, which is partly floated in mercury. With every change in the weight on the conveyor the plunger instantly adjusts itself to a new position, thereby changing the level of the mercury. The rheostat consists of double wound coils connected to contact points in the mercury chamber. As the mercury level rises and falls the resistance changes. The recording instrument may be placed in a nearby office or close to the scales. These scales are manufactured by the Electric Weighing Company, New York City, and have been thoroughly tested under a variety of conditions, and are no longer an experiment.



SCALE FOR WEIGHING BULK MATERIAL IN MOTION.

Items of Personal Interest

Mr. R. H. Hall has been appointed locomotive foreman of the Grand Pacific, with office at Regina, Sask.

Mr. J. W. Findlay has been appointed general foreman on the Canadian Northern, with office at Perry Sound, Ont.

Mr. Joseph Fritts has been appointed foreman of the Atchison, Topeka & Santa Fe, with office at Syracuse, Kan.

Mr. John Kerr has been appointed road foreman of engines of the Canadian Northern with office at Joliette, Que.

Mr. William V. Wicks has been appointed road foreman of engines on the Northern Pacific, with office at Jamestown, N. D.

Mr. R. A. Miller has been appointed general foreman of the Ottawa division of the Eastern lines of the Canadian Northern, at Trenton, Ont.

Mr. Harry Fleming, formerly with the Chicago & Alton, has been appointed assistant foreman on the Baltimore & Ohio, with office at Cumberland, Md.

Mr. F. Gouge has been appointed foreman of the car department of the Lake St. John division of the Canadian Northern, with office at Limoilou, Que.

Mr. A. E. Reid has been appointed supervisor of signals of the Chicago & North Western, with office at Boone, Iowa, succeeding Mr. K. E. Kellenberger, resigned.

Mr. Jay G. Coutant, formerly engineer of the plant of the Lima Corporation, Lima, Ohio, has become associated with the Railway Materials Company, Illinois.

Mr. C. A. Zweibel has been appointed supervisor of car repairs of the Atlantic Coast Line, with office at Wilmington. N. C., succeeding Mr. E. A. Sweeley, resigned.

Mr. W. C. Moore has been appointed road foreman of engines of the Ottawa division of the Eastern lines of the Canadian Northern, with office at Trenton, Ont.

Mr. William Schumann has been appointed foreman of shops of the Indianapolis & Louisville, with office at Lafayette, Ind., succeeding Mr. George Crumbo, resigned.

Mr. S. S. Senter, formerly engineer of construction of the Wheeling & Lake Erie, has been appointed superintendent of bridges and buildings on the same road, with office at Brewster, Ohio.

Mr. H. O. Fettinger has been appointed Eastern railroad representative of the Ashton Valve Company, Boston, Mass., with office at 128 Liberty street, New York, succeeding Mr. W. H. Foster.

Mr. Joseph Billingham has been appointed superintendent of motive power of the Grand Trunk Pacific, with office at Transcona, Man., succeeding Mr. G. W. Robb, resigned.

Mr. John Engels, formerly master blacksmith of the Big Four at Bellefontaine, Ohio, has been appointed master blacksmith of the Georgia Railway, with office at Augusta, Ga.

Mr. C. E. Lester, formerly boiler inspector for the American Locomotive Company, has been appointed to a similar position for the Lima Locomotive Corporation, Lima, Ohio.

Mr. William O'Brien has been appointed master mechanic of the Illinois Central, with office at Clinton, Ill., succeeding Mr. Fred M. Baumgardner, who has accepted service with the government.

Mr. E. H. Peck, formerly assistant engineer of the Chicago, Burlington & Quincy, has been appointed engineer of the Missouri district, with offices at St. Louis, Mo., succeeding Mr. F. M. Paterson, resigned.

Mr. F. E. Cooper has been appointed machine shop foreman of the Pittsburgh & Lake Erie, with office at McKee's Rocks, Pa., and Mr. Otto Braun has been appointed assistant foreman on the same road, also at McKee's Rocks.

Mr. J. J. Sullivan, formerly master mechanic, on the Louisville & Nashville R. R. at New Decatur, Ala., has been appointed superintendent of machinery on the Nashville, Chattanooga and St. Louis R. R., with offices at Nashville, Tenn.

Mr. G. F. Shull has been appointed acting master mechanic on the Carolina, Clinchfield & Ohio, in place of Mr. H. F. Staley, resigned, and Mr. W. S. Moseley has been appointed mechanical engineer on the same road, both with offices at Erwin, Tenn.

Mr. T. S. Lowe, formerly road foreman of engines on the Canadian Northern, has been appointed master mechanic on the same road, with office at Limoilou, Que., and Mr. T. C. Hudson has been appointed master mechanic of the Quebec Grand division, with office at Joliette, Que.

Mr. John A. Marshall has been appointed road foreman of engines of the Northern Pacific, with office at Duluth, Minn., and Mr. Melvin Montgomery has been appointed to a similar position on the same road, with office at Staples, Minn.

Mr. H. I. White has been appointed general foreman of the car department on the Quebec division of the Canadian Northern, with office at Joliette, Que., and Mr. J. Hodgson has been appointed foreman, car department on the same road, also at Joliette.

Mr. R. C. Earlywine has been appointed assistant air brake inspector of the second and third districts of the Chicago, Rock Island & Pacific, with office at El Reno, Okla., and Mr. H. E. Reynolds has been appointed to a similar position in the same road, with office at Des Moines, Iowa.

Mr. W. J. Rennix has been appointed district master mechanic on the Canadian Pacific, with office at Calgary, Alta., and Mr. G. Glasford has been appointed to a similar position at Cranbrook, B. C., and Mr. T. J. Brown has been appointed resident engineer and bridge and building master, also at Cranbrook.

J. H. Sanford, formerly purchasing agent of the New Haven road, has been appointed purchasing agent of The Connecticut Company, and will also buy for the Housatonic Power Company, the Berkshire Street Railway Company, the New York & Stamford Railway Company, the Westchester Street Railroad Company and the Westport Water Company.

In line with the policy the New Haven is now pursuing of curtailing expenses in every way possible, it is thought that H. A. Fabian, director of purchases, can handle the business without Mr. Sanford's assistance so that the latter can take charge of the purchases for the trolley companies and look closely after every detail in connection with those companies.

The appointment of an independent purchasing agent for the trolley companies is the last step in giving those companies a complete organization of their own, entirely independent in every way of the New Haven management.

Mr. Sanford will make his headquarters in New Haven, and in purchasing will try to patronize home industries to the greatest possible extent.

Mr. David Van Alstyne is appointed assistant to the vice-president of operation on the New York, New Haven & Hartford, with headquarters in New York, in charge of the test and store departments, and of handling scrap. Mr. Van Alstyne will also have supervisory authority over the mechanical department in regard to organization, shop practice, approval of design, standards, and requisitions.

Mr. W. D. Deveney, formerly general foreman of the Santa Fe shops at Newton, Kan., has been appointed master me-

chanic on the same road at La Junta, Col., in place of Mr. Hugh Gallagher, resigned. Mr. W. R. Harrison has been appointed general foreman at Newton, Kan., and Mr. W. S. Whatley and Mr. Earl Preston have been appointed storekeepers, the former at Canadian, Tex., and the latter at Waynoka, Okla., all on the Santa Fe.

Mr. F. L. Stuart, chief engineer of the Baltimore & Ohio Railroad, has been named by Mayor John Purroy Mitchel, of New York, as a member of the advisory committee on port development. It is planned by the New York authorities to work out a comprehensive plan of enlarging the shipping facilities of the city, both of water and rail traffic, and in such connection the co-operation of the railroad companies entering that city is sought. Mr. Ralph Peters, president of the Long Island Railroad, and P. J. Flynn, vice-president of the Delaware, Lackawanna & Western Rairoad, will serve on the advisory committee with Mr. Stuart.

Mr. Morgan K. Barnum, formerly general mechanical inspector of the Baltimore & Ohio, has been appointed superintendent of motive power of the same road, with office at Baltimore, Md. Mr. Barnum has had a notable career as a railway man. Previous to his appointment as general mechanical inspector in the Baltimore & Ohio he was superintendent of motive power of the Illinois Central, and previously superintendent of motive power of the Chicago, Rock Island & Pacific. He has been prominently identified with the Master Car Builders' and Master Mechanics' Association and was president of the former association in 1913-14. He graduated from the Syracuse University with the highest honors in 1884, and entered railway service as special apprentice in the shops of the New York, Lake Erie & Western at Susquehanna, Pa., since which he has been consecutively, to September, 1887, machinist and mechanical inspector, and general foreman on the same road from 1887 to 1889 at Salamanca, N. Y. In the latter year he was appointed general foreman on the Louisville & Nashville, at New Decatur, Ala., and from September, 1889, to September, 1890, assistant master mechanic on the Santa Fe, at Argentine, Kan.; September, 1890, to June, 1891, superintendent of shops Union Pacific at Cheyenne, Wyo.; June, 1891, to December, 1898, district foreman, same road at North Platte, Neb.; December, 1898, to December, 1902, Nebraska division, same road, at Omaha, Neb.; December, 1902, to February, 1903, assistant mechanical superintendent on the Southern; February, 1903, to April, 1904, he was superintendent of motive power on the Rock Island, as already stated. Mr. Barnum is an all around railroad man of the best type and much esteemed by all who have the honor of his acquaintance.

At the last convention of the Traveling Engineers' Association Mr. Frank P. Roesch was elected president of the organization, a most worthy choice. Mr. Roesch is remarkably well informed on railroad mechanical subjects, and is a remarkably good writer, many articles from his pen having appeared in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING.

Mr. Roesch was born in Alsace,

MORGAN K. BARNUM.

France, and emigrated in this country with his parents when six years old, landing at Chicago, where he first entered school, finally graduating from high school at the age of thirteen. At the same time he was studying mechanical engineering under the direct tuition of

FRANK P. ROESCH.

his father, who was a graduate of Oxford, England, and Heidelberg, Germany. His parents moving west he entered the employ of the C. R. I. & P. Ry., at Trenton, Mo., as machinist apprentice, and at completion of his apprenticeship went to Denver, Colo., with his parents, his father having taken a position as mechanical engineer of the Denver & South Park Railroad, with which road Frank also identified himself as a machinist. In 1883 he was sent to Gunnison, Colo., as roundhouse foreman. Leaving that point in November of the same year he entered the service of the Rio Grande Western at Salt Lake City, Utah; first as machinist, afterward as locomotive fireman. From there he emigrated to Sacramento, Cal., and was there employed, first as a locomotive fireman, afterward as machinist; laid off on account of slack business, and was next employed as division foreman at Winslow, Ariz., on the Atlantic & Pacific Railroad, now the Santa Fe.

He resigned in the spring of 1885, knocking about the country and finally landing at Fernandina, Fla., where he took the position of general foreman with the F. R. & N. Railroad, resigning at the end of a year to take position of locomotive engineer. On account of the death of his father in Denver, in 1886, he returned to Denver and was first employed as general foreman of the D. & N. O. Ry., now the C. & S., and upon the completion of the road took position of locomotive engineer, serving as both freight and passenger for nearly ten years, when he was promoted to the position of road foreman of engines in 1899, and in 1901 to the position of general traveling engineer of the C. & S. Ry., and the Santa Fe joint tracks. During the time he was employed as general traveling engineer he spent most of the time in conducting various tests, such as indicator, dynamometer, etc., and established tonnage ratings for all locomotives over the entire C. & S. System. In the spring of 1903 he was offered a position as master mechanic of the C. & A. Ry., at Slater, Mo., which he accepted and held until he took the position of general manager of the Hicks Locomotive & Car Works, Chicago, Ill., January 1, 1905. Owing to the continued ill health of his family he was obliged to resign this position after two years, and accepted the position as master mechanic with the Southern Ry., first at Birmingham, Ala., and later transferred to Spencer, N. C., the Spencer shops being the largest shops on the Southern Ry. at that time. As the health of his family did not improve he was again compelled after two years to resign, in order to find a drier climate at a higher altitude, accepting his present position in November, 1908.

These notes show that Mr. Roesch has enjoyed a highly varied experience, most of the changes having been owing to the delicate health of his wife. Honorary membership in the Master Boiler Makers' Association was conferred upon Mr. Roesch for the work done on the association's rules and formulas. In a high degree he combines the practical and the scientific department of mechanical engineering.

RAILROAD NOTES.

The Georgia is said to be in the market for four Mikado locomotives.

The Detroit, Toledo & Ironton is in the market for 10 locomotives, it is said.

The Rutland has ordered 100 hopper cars from the Standard Steel Car Company.

The Carolina & North Western is in the market for one hundred 30-ton box cars.

The Erie has ordered a Santa Fe type locomotive from the Baldwin Locomotive Works.

The Winston-Salem Southbound is said to be in the market for thirty-five freight cars.

The Warren, Jonsville & Saline River is in the market for three miles of 56-lb. relaying steel.

The Albany Southern is in the market for 10 freight cars and one express car and snow plow.

The Havana Central has ordered twelve passenger cars from the Wason Manufacturing Company.

The Rutland has ordered 75 50-ton steel hopper cars from the Standard Steel Car Company.

The Lehigh & Hudson River has ordered 20 50-ton ore cars from the Pressed Steel Car Company.

The Chicago, Milwaukee & St. Paul is said to be preparing to erect a roundhouse at Beloit, Wis.

The Western Pacific is reported to have plans for expenditure of $10,000,000 for the construction of feeders.

The Williamsville, Greenville & St. Louis has two locomotives and a Bucyrus steam shovel for sale.

The Argentine Railways are reported to have placed an order with American makers for 35,000 tons of rails.

The Toledo, St. Louis & Western has placed an order for 500 tons of rails with the Lackawanna Steel Company.

The Atlanta, Birmingham & Atlantic has ordered five Mikado locomotives from the Baldwin Locomotive Works.

The Minneapolis, Dakota & Western is in the market for four locomotives, and has four locomotives for sale.

The Louisville & Nashville has given a contract to Rommel Bros., Louisville, Ky., to build a roundhouse, shops, etc., at Lexington, Ky.

The Chicago & Alton has authorized construction of nine new stalls to its roundhouse at Brighton Park, Chicago, at an estimated cost of $12,000.

The Cincinnati, Hamilton & Dayton has ordered 1,000 box cars from the Standard Steel Car Company, and 1,000 gondola cars from the Cambria Steel Company.

The Nashville, Chattanooga & St. Louis has given the Union Switch & Signal Company a contract for installing an electro mechanical interlocking plant at Cravens, Tenn.

The Southern Wheel Company, of St. Louis, Mo., will erect a $60,000 building at its carwheel plant in Atlanta, Ga., and will increase its manufacture of cast-iron car wheels.

The Pennsylvania Lines West have placed orders for 60,000 pairs of splice bars, dividing the order equally between the Carnegie Steel Company and the Illinois Steel Company.

The Cleveland, Cincinnati, Chicago & St. Louis has made application to the Ohio public utilities for permission to issue notes which will be used as part payment for 18 locomotives.

The Northwestern Pacific has ordered 4 ten-wheel passenger locomotives, 2 ten-wheel freight locomotives and 3 six-wheel switching locomotives from the American Locomotive Company.

The Baltimore & Ohio has closed contracts for 9,000 tons of rails, distributed among the Carnegie Steel Company, Cambria Steel Company and Tennessee Coal, Iron & Railroad Company.

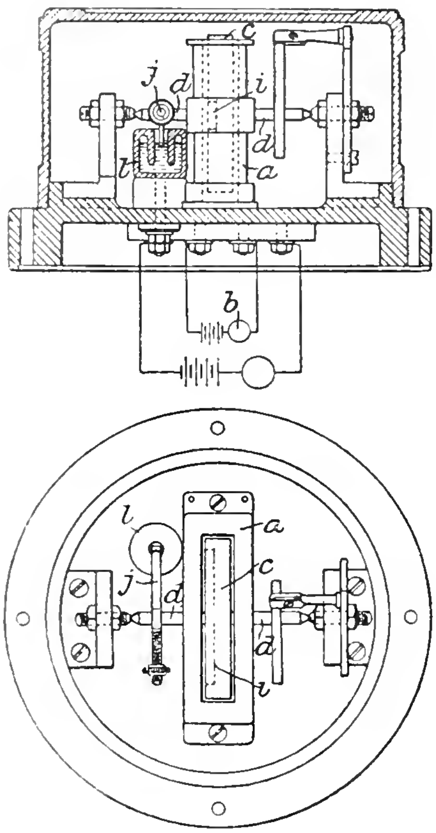
The Cincinnati, Hamilton & Dayton is in the market for twelve 70-ft. coaches and one 73-ft. steel dining, 8 70-ft. passenger and baggage, five 70-ft. baggage and mail and four 70-ft. baggage cars.

The Southern has awarded contract to I. C. Abbott, of Brandy, Va., for a generator house at Whittles, Va., to be used in connection with installation of automatic signals between Amherst and Whittles.

The Southern has given a contract to the Consolidated Engineering Company, Calvert building, Baltimore, Md., for a roundhouse at Forrest yards, Buntyn, near Memphis, Tenn., at an estimated cost of $60,000.

Improvement in Wireless Telegraphy.

An improvement in wireless telegraphy has just been patented by C. P. Ryan, Marconi House, London, England, whereby an alarm is given on the receipt of a series of timed signals which a correspondingly-timed balance-wheel controlling a local circuit. As shown in the



IMPROVED WIRELESS APPARATUS.

accompanying illustration there is a balance wheel, c, having an iron inset, i, which is mounted on a spring-controlled spindle, d, carrying a counterweighted contact-arm, j, above a mercury cup, l, the wheel c being arranged within a coil, a, controlled by a relay b on the detector circuit.

Electricity in Modern Warfare.

It is not generally understood how widespread and important is the use of electricity in modern warfare, as it is now being waged in Europe between Germany and Austria on the one hand and "The Allies" on the other. Without electricity little could be accomplished, for it is used very extensively: it sparks the gasoline engine of the swift flying armoured air ship and the heavily loaded motor truck of the commissary department; it revolves the turrets and controls the fire of the great battleships; it sets off the mines which destroy these superdreadnoughts; it transmits the messages from the various parts of the battle line to headquarters, enabling the general in command to know immediately of any move made by the enemy.

For the purpose of showing how important a part electricity plays in modern warfare, the army and navy of the United States, is arranging a series of special exhibits to be included in the Electric Exposition to be held in New York City the second week in October.

One of exhibits will show the use of electricity in coast defense service. It will embrace the mining of harbors, handling of big guns, signal devices and lines of communication, the use of searchlights, etc., in all of which electricity plays a more or less important part.

The Navy will exhibit a model of the bridge of a battleship, complete in every detail and showing how electricity is used to control the great fighting ships of this nation. Other features of the Navy exhibit will show how electricity is employed in submarines and the new electric cooking range for warships, described in a previous issue of this paper, will be on exhibit.

A small arsenal, fully equipped and engaged in making ammunition, is to be exhibited by the Ordnance Department of the U. S. Army. The electrically operated machinery and the officers and men who will use it in making ammunition will come from the Frankford Arsenal at Philadelphia.

Air Brake Story Contest.

The names of the prize winners in the Westinghouse Air Brake Company's competition for the best air brake story, are as follows: First prize, $1,000, Mr. Jas. Cain, engineer, Wabash Railroad, Peru, Ind. Second prize, $500, Mr. H. C. Woodbridge, general manager's special representative, Buffalo, Rochester & Pittsburgh Railroad, Rochester, N. Y. Third prize, $200, Mr. Alex. M. Stewart, engineer, Illinois Central Railroad, McComb, Miss. Fourth prize, $150, Mr. D. Oxenford, road foreman of engines, Lehigh Valley Railroad, New York, N. Y. Fifth prize, $100, Mr. Carl H. Fuller, chief engineer, Macon Railway & Light Company, Macon, Ga. Sixth prize, $50, Mr. Millard F. Cox, assistant superintendent machinery, Louisville & Nashville Railroad, Louisville, Ky.

Scots Historical Question Answered.

A question often put to children in Scot schools is, How did it happen that James VI was born in Linlithgo Palace? The Mother Queen, Mary, had quarrelled with her husband in Holyrood Palace and started for Stirling, but had to stop off at Linlithgo, where the child was born. On the question being put to a large class of children, silence for a time till a bright little girl held up her hand and exclaimed, "Because his mother was there."

Books, Bulletins, Catalogues, Etc.

Buffalo, Rochester & Pittsburgh Annual Report.

Among the attractive publications that come annually to this office is the annual report of the Buffalo, Rochester & Pittsburgh Railway Company, which comes with the compliments of our old friend, Mr. William T. Noonan, president of the company.

The year ending June 30, 1914, has been by no means an era of prosperity to many railroads, but the report mentioned shows that the Buffalo, Rochester & Pittsburgh has been a little more fortunate than most of its neighbors. There has been a slight increase of mileage, but decrease in net operating revenue which comes from the extra financial burdens imposed upon railroads by taxes. Considerable additions have been made on equipment during the year, three new passenger locomotives, twelve freight locomotives, and 27 steel passenger cars having been purchased, besides a variety of other rolling stock at a total cost of $1,628,857.

The detailed account of income and expenditures makes interesting reading, but it is not adapted to these pages. A careful study of the report gives the impression that the Buffalo, Rochester & Pittsburgh Railway is a very well managed property, and that President Noonan deserves high credit for the same.

Fuel Oil.

Those who are interested in appliances for burning fuel should send for a copy of the Catalogue of Appliances for burning fuel oil to Tate, Jones & Co., Empire Building, Pitsburgh, Pa. Oil fuel is now competing all over the United States with coal. Twenty-five per cent. more heat is procurable from the oil. It is forty per cent. less in weight, and thirty-five per cent. less in bulk. It can be stored at less expense and does not deteriorate when stored. It is burned almost completely. Much of the heat from coal passes through the stack. The catalogue shows all kinds of appliances with the tabulated results of tests which, to say the least, are convincing.

The Railroads' Appeal.

Seven presidents of the leading railroads of America called on the President of the United States last month and made a strong appeal for more sympathetic treatment by the Government towards the railroads. The appeal is published in circular form and is stirringly eloquent. As is well known the great increase in expenses now coincides with seriously depleted revenues, with no corresponding ability of the railroads to reduce their costs in proportion. Governments can proceed with expenditures of all kinds by taxation, but railroads cannot. While the effect of the European war upon railroad earnings may vary in different sections, it is painfully evident that there will be serious decreases in the total because of the unprecedented difficulties in the marketing of cotton, the great decrease in imports, and the general dislocation of trade and industry.

Sand Blast Equipment.

The De La Vergne Machine Company, New York, has issued an interesting pamphlet on The Sand Blast from the users' viewpoint, being a paper read at a meeting of associated foundry foremen of New York and vicinity. It gives valuable practical points on the selection and operation of sand blast equipment. As is well known the railroads are today practically unanimous in demanding the sand blasting of steel cars before painting, which not only gives a better surface with a corresponding better finished job, but also prevents inward corrosion which is very important. The same remarks apply to bridge building. The gates of the Gatun Locks are an excellent example. Forging machines are also sand blasted to save the dies and prevent the slipping of metal under the dies. In electric welding the appliance frees the parts from scale. The appliance appears in many forms and every individual condition can be successfully met. Copies of the pamphlet and other details may be had on application to the De La Vergne Company.

"National" Bulletin.

The National Tube Company's "National" Bulletin, No. 9-C, contains very interesting matter in regard to some tests of "Kewanee" unions with tabulated details, including tests to which every individual "Kewanee" union is subjected, as well as actual service tests which were disconnected and reconnected over one thousand times, and which remained tight at the end of the tests. No better proof of the absolute reliability of the company's fine products could be had. Copies of the bulletin may be had on application. Address National Tube Company, Frick Building, Pittsburgh, Pa.

Electric Fans.

It is pleasant in the sweltering spasms that we have experienced during the torrid spells of the vanished summer to recall the electric fans used by sensible hotel men and by thoughtful railway officials who give some thought to the com-

fort of passengers. The Safety Car Heating & Lighting Company, No. 2 Rector street, New York, in Vol. 4, No. 1, of their publications presents facts in regard to their latest devices in the use of electricity in driving fans. Future generations will arise and call the company blessed among manufacturers, not because it is more blessed to give than to receive, but because their appliances fill a long felt need. Get a copy of the *Safety Heating and Lighting News*, and learn about the company's thoughtful ingenuity.

Flexible Staybolts.

A comparative fire box record covering an Atlantic type locomotive rigidly stayed from 1901 to 1907, and with a complete Tate Flexible Staybolt installation from 1907 to date, is given for the purpose of careful analysis in the consideration and study of all points dealt with in the discussion arising from the use of flexible staybolts, and now published by the Flannery Bolt Company in Vol. 2, No. 4, makes very interesting reading, and shows that the cost of engine time lost due to continuous staybolt breakage, fire sheet cracking and all consequent renewals, and the constant inspection necessary, regardless of the cost of materials, labor and time involved for maintenance repairs, is left to the consideration of those who know, by experience, the full value of the engine flexibly stayed, as an earning factor, compared to its value when rigidly stayed.

International Expositions.

The gorgeous pamphlets issued by the exhibition companies on the Pacific coast in regard to the exhibition to be held in 1915 are quite an artistic show in themselves. Apart from that there is much valuable information in regard to railroad rates which are nearly less than half price. Those who think of going should secure copies of these illustrated pamphlets from Mr. A. M. Mortenson, traffic manager, San Francisco, Cal.

Baldwin's Record, No. 79.

The publications of the Baldwin Locomotive Works are in keeping with the high standard of excellence maintained by the enterprising company. Their latest illustrated booklet shows Pacific type locomotives for all kinds of services. Eighteen different kinds are shown with full details running from 170 to 240 tons weight. An admirable essay on their comparative hauling qualities is also attached. Copies may be had on application to the company's office at Philadelphia, Pa.

It may interest some of our readers to learn that there is published in Edinburgh a very bright monthly magazine called *The Scottish Nation.* A good picture of Dr. Angus Sinclair apears on the front page of the October number.

Magistrate—"You say this man stole your coat? Do I understand that you prefer the charge against him?"

Prosecutor—"Well, no, Your Honor, I prefer the coat, if it's all the same to you."

An Irishman in France had been challenged to a duel. "Sure," he cried, "we'll fight with shillelaghs." "That won't do," cried the second, "as the challenged party you have the right to choose the weapons, but chivalry demands that you should decide upon a weapon with which Frenchmen are familiar." "Is that so?" said the generous Irishman; "then we'll fight it out with guillotines."

Teaching the Young Idea to Shoot.

A keen-eyed but obviously scantily educated mountaineer led his gawky, overgrown son into a country schoolhousue.

"This here boy's arter larnin'," he announced. "What's yer bill o' fare?"

"Our curriculum, sir," corrected the schoolmaster, "embraces geography, physiology, arithmetic, algebra, trigonometry——"

"That'll do," interrupted the father. "That'll do. Load him up heavy with triggernometry. He's the only poor shot in the family."—*Youth's Companion.*

Eggstraordinary.

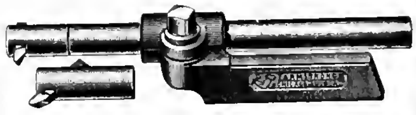
"When I arose to speak," related a martyred statesman, "some one hurled a base, cowardly egg at me and it struck me in the chest."

"And what kind of an egg might that be?" asked a fresh young man.

"A base, cowardly egg," explained the statesman, "is one that hits you and then runs."

Mixed on Measurement.

Mr. W. A. Garrett, vice-president of the Chicago & Great Western, besides being an able executive officer, is decidedly a humorist. Speaking at the Traveling Engineers' Convention he quoted a lot of figures then excused himself saying that figures reminded him of a colored woman's answer in court: Judge: How old are you? I'm sixty-eight, Judge. No, you are not sixty-eight, Mandy. You are a young girl. Yes, sah, I am sixty-eight, Judge. No, you aren't, you are a young girl. What did I tell you, Judge? Well, you said that you were sixty-eight. I ain't sixty-eight, Judge. I'm twenty-four years old. Sixty-eight is my bust measurement, Judge.



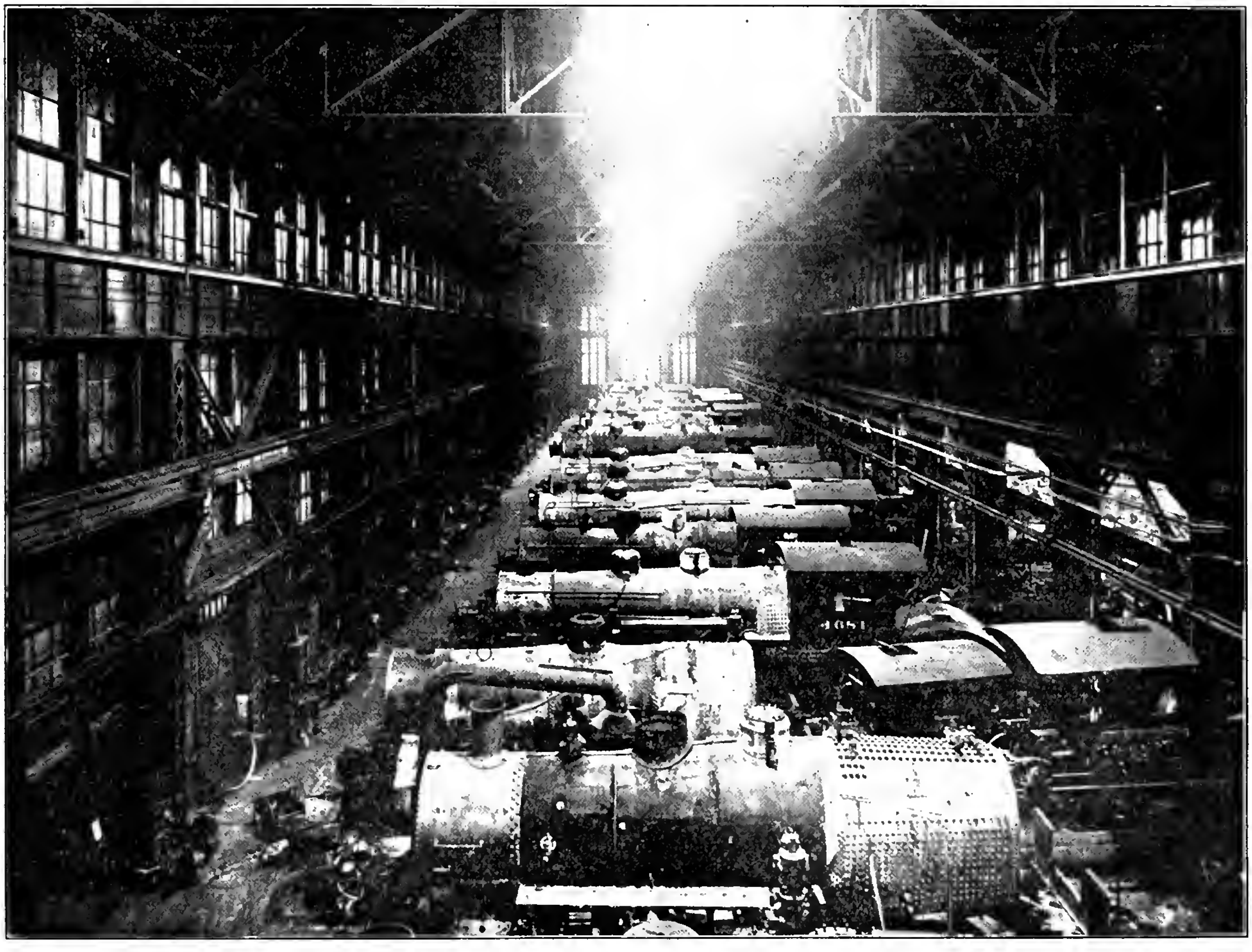
Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, November, 1914. No. 11

Illumination of the Collinwood Shops

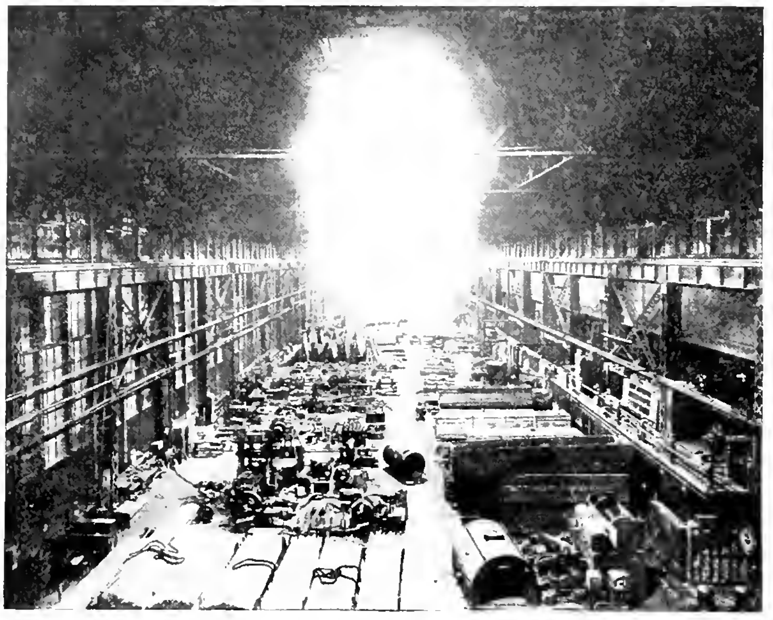
Since the establishment of the principal railway shops on the Lake Shore & Michigan Southern Railway at Collinwood, Ohio, the mechanical plant has been marked by a degree of completeness of equipment that has not been surpassed by any other railroad repair works in America. It was the first shop where the method of grouping the various construction and repair gangs in separate sections was perfected, and which has been extensively and successfully imitated on other roads where new shops have been established, among the more recent being the main shops of the Lackawanna at Scranton, Pa. As is well known, the grouping system consists of confining all of the operations necessary to any particular appliance to a limited area, as for example, in the machining and fitting of a driving box every operation is within reach of a special jib crane that is used for no other purpose than moving the box from place to place as may be necessary during the operations.



LOCOMOTIVE ERECTING SHOP OF THE LAKE SHORE & MICHIGAN SOUTHERN RAILWAY, COLLINWOOD, OHIO.

Mr. D. R. MacBain, the superintendent of motive power, perhaps the most accomplished authority on boiler construction and repair in America has ably supplemented the admirable system in vogue, and every new mechanical appliance of value is immediately requisitioned for service in the shops. The most recent

addition to the shop appliances is the introduction of the most advanced method of shop lighting. It may properly be said that the manifold advantages of having adequate illumination in an industrial plant are being realized by no class of operators more readily than the farseeing railroad men. Not only does the proper illumination of a shop mean a better and more efficient class of work turned out, but exhaustive tests recently made in a number of large industrial plants proved conclusively that a workman naturally made a gain of considerable time per day in the production of a given piece of work, owing entirely to the better illumination with which he was supplied. These few minutes when multiplied by a large number of workmen amount to a considerable item.



LOCOMOTIVE BOILER SHOP: VIEW TAKEN BY ARTIFICIAL ILLUMINATION.

The first of the accompanying illustrations shows a view of the locomotive erecting shop at Collinwood. The other two are views in the boiler shop. The photographs were taken at night, and as will be noted at a glance, the illumination is abundant but entirely without glare or shadows, reaching every part of the shop. The buildings are 528 feet long and 58 feet wide, giving an area of 30,624 square feet in each building.

The illumination for these buildings is furnished by type Z Cooper Hewitt Quartz lamps operating in a 220-volt direct current circuit. This lamp is a modification of the well-known Cooper Hewitt lamp based on the same fundamental principles, but possessing some essential differences. The lamp uses the mercury vapor, and a short tube of pure fused quartz instead of the long tube of lead glass used in the older types.

Ten lamps are installed in the boiler shop placed at regular intervals of 52 feet down the middle of the building, each lamp lighting an average of 3,062 feet. In the erecting shop there are twelve lamps regularly spaced down the middle of the building at intervals of 44 feet, giving an average space lighted by each lamp of 2,552 feet. All the lamps are hung at a height of 50 feet above the floor. The lamps are rated at 2,400 candle power, with an energy consumption of 725 watts, or a total for the installation of approximately 16 kilowatts.

The light afforded by these lamps is entirely sufficient for all purposes even the locomotive pit being well illuminated. The only other form of artificial light required is a portable hand lamp needed by the workman when he goes inside the boiler.

The total lumens per lamp from these units is 14,603, with a total available in a zone of 0 to 60 degrees of 10,800 lumens per lamp which, with a wattage of 725 gives a value of 20.2 total lumens per watt, and 14.9 available lumens per watt. The efficiency of the system as installed is made evident from the low wattage consumption obtained per square foot, these being .28 for the erecting shop and .24 for the boiler shop, the former being said to be the best lighted erecting shop in the country. The average candle feet obtained are 4.24 for the erecting shop and 3.53 for the boiler shop.

No better evidence of the success of the installation from a practical viewpoint can be secured than the universal commendation of the employees who are working under the light. They are universally pleased with it and the results they are able to obtain. It is interesting to note, however, that when a trial installation of four lamps was first made, there was a certain antipathy to the light on the part of the men employed, because of the difference in color value, but this speedily disappeared after they gave it a thorough trial. This trial resulted in the adoption of the complete installation of these units. The lamps have been installed at various times, but the entire installation averages practically 16 months, and the maintenance change for the period totals $134.54, or $4.58 per lamp per year.

Doubtless the very successful installation of this superior method of lighting in these extensive shops will be rapidly followed in many others of the larger industrial plants in America, as it is a well known fact that in many of the mechanical establishments, especially in railroad machine shops, the lighting systems in vogue are capable of much improvement.

LOCOMOTIVE BOILER SHOP: VIEW TAKEN BY ARTIFICIAL ILLUMINATION.

In the White Mountains on the Maine Central Railroad

Many of that bewildered bunch of American tourists who were caught in the war cyclone in the heart of Europe, and had, what they choose to call, harrowing experiences in getting back beneath the starry banner again, are taking a trip to the White Mountains to cool their fevered brows. They have found the Maine Central Railroad something superior to the ramshackle equipment of Central Europe. They have found not only comfort and convenience, but luxurious elegance. And as for scenery and variegated wonders of the blessed region it has the Alps and the Carpathians frozen stiff. Engineering skill has overcome many difficulties in constructing a great railroad through the mountainous regions. True, the glamor of tradition is dim and shadowy in the mist-mantled region, but so is the weight of prejudice far removed, and it is the sweet air of freedom that one breathes among the green woods and it is civilization in its highest degree of perfection that one meets among the social and cultured people.

The railroad equipment, as we have said, is of the best. Not only so, but the cry of safety that is now rising from ten thousand throats has always been a watchword on the Maine Central, even when at times under managements that were more anxious about large dividends than small casualty lists. In this regard there are no railroads in America, with the exception of some of the Canadian railroads, where the traffic is limited and the liability to accident not so great as on some of our congested roads, that can compare with the safety record of the Maine Central.

But coming back to the tourists, of course they think little or nothing of all this. All they see is the ever-varying panorama of nature in her beauty and solitude. They can see that the fiery finger of October has transfigured the dark forests into variegated flame. Russet and scarlet and gold, like a royal mantle, are spread over the woody wilderness. Silvery streamlets leap from cataract to cataract. Crystal lakes studded with a far-spreading archipelago of emerald islands reflect, as in a mirror, the glories of heaven and earth. At night the burnished constellations seem glowing in electric fire. Even the sounds are new and strange. The multitudinous murmurs of the enchanting region have a charm all their own. There the solitary loon calls from lake to lake. Yonder a wild bird screams. Weird echoes pass from valley to valley, like the voices of creatures that might inhabit some strange planet. Presently there is a far-off locomotive whistle, and we are back in the busy world again.

TRAINS OF THE MT. WASHINGTON RAILROAD AT SUMMITT STATION.

WILLEY HOUSE BRIDGE ON THE MAINE CENTRAL RAILROAD.

Next year we will not trouble ourselves about Europe at all, but we will go North among the Maine woods earlier and be able to say more about a region where the wicked cease from troubling and where the weary are at rest.

General Correspondence

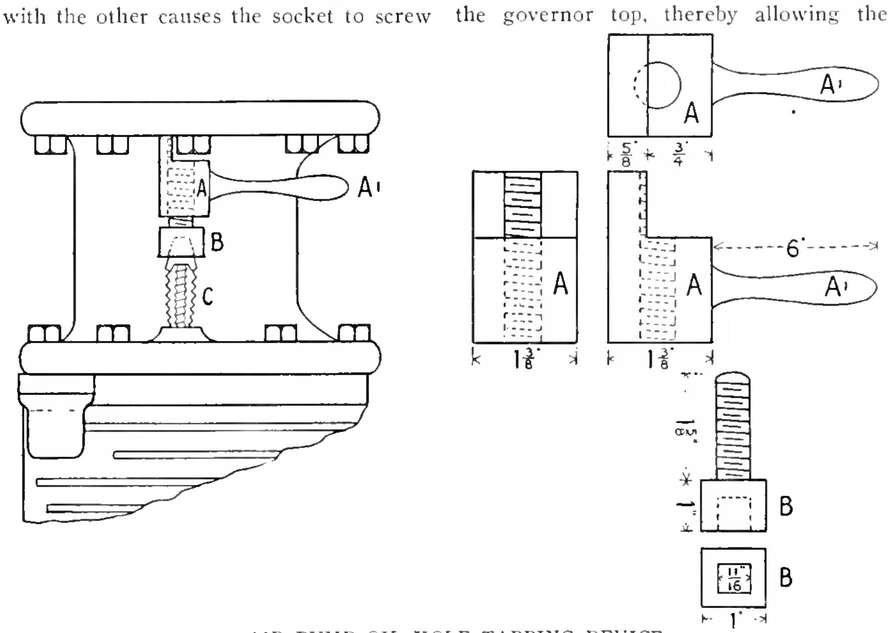
Air Pump Oil Hole Tapping Device.

EDITOR:

The device shown in the illustration has proven to be most efficient in retapping defective oil holes in the centerpiece of Westinghouse Air Brake Company's air pumps and consists of a steel nut and handle (A), a socket (B) and ⅜ in. pipe tap (C). The shank of the socket is threaded to fit nut (A). Nut (A) is tapped with a ⅜ in. straight pipe tap.

A ⅜ in. combined tap and drill (with the drill end cut down as short as possible) is used. Turning the socket and drill with one hand and holding the nut with the other causes the socket to screw out of nut, which in turn forces the drill end into the old tapping, the threads being the same on the tap and socket, producing a uniform thread in the centerpiece.

J. A. JESSON,
Louisville & Nashville Ry.
Corbin, Ky.



AIR PUMP OIL HOLE TAPPING DEVICE.

S. F. Governor.

EDITOR:

I have read with interest the articles in recent issues of RAILWAY AND LOCOMOTIVE ENGINEERING concerning the use of the S. F. governor. I would be inclined to favor Mr. Jones' idea. While Mr. Hahn has given a number of causes which might cause throttling of the pump, they seldom happen, and are practically unheard of in road service, where the proper inspection is given locomotive brake apparatus before leaving the roundhouse.

The real reason for the throttling of the pump is the leaky train line. Another reason is the failure of enginemen to keep the brake valve handle in release position when charging up an empty train, or, one whose pressure has partly leaked away while the engine has been cut off.

Allowing that the locomotive brake apparatus is up to the standard, as Mr. Hahn states, the throttling of the pump is still possible, because the pipe to the spring chamber of the S. F. governor (excess pressure top), being piped from the feed valve pipe, any drop in the feed valve pipe pressure will cause a drop also in the chamber above the diaphragm of the governor top, thereby allowing the pressure below to raise the diaphragm and pin valve, thereby throttling the pump. Now, with the brake valve in running or holding position and the brake pipe being supplied by the feed valve, it is plainly evident that with the one hundred car trains of today, brake pipe leakage is possible which would overtax the feed valve, thereby reducing the pressure in the feed valve pipe, also the spring chamber of the governor top, thus causing the governor to operate and stop the pump.

The greatest number of failures of this sort happen when the air is cut into an empty train and the brake valve handle is allowed to remain in running position. To overcome this the valve should be placed in release position in order to aid the feed valve to keep its proper pressure in the feed valve pipe. The pump will then continue to operate while the train is being charged.

The S. F. governor is without doubt a valuable feature of the E. T. equipment, when accompanied by proper manipulation and a tight train line, but until some method is devised to reduce the train line leakage, due mainly to poor and frozen hose and gaskets, defective draft rigging, etc., the S. D. governor is the proper thing to overcome the delays and annoyances that accompany these conditions.

Regarding the undue wear on the steam valve and its seat: This, in my opinion, is more noticeable where two pumps are in use. Where one pump was being used formerly, the small amount of steam admitted when the valve commenced to open was sufficient to start the pump immediately and raise the pressure the required amount for closing the steam valve. Now, with two pumps this same amount of steam is divided between the two, causing them to "drag," and the steam valves to fluctuate slowly because the rise in air pressure is not positive enough to close it.

This fluctuation of the governor causes an increased amount of wear on the parts and allows an increased amount of steam to flow up past the piston stem, carrying with it oil which in time brakes onto the air piston and ring in the lower chamber of the governor and produces more leakage of air past the ring to the atmosphere, which also tends to keep the pumps "dragging."

JOHN S. QUINN.
Air Brake Insp., B. & M. R. R.

New England Narrow Gauge Road.

EDITOR:

I am enclosing a photographic view of the rolling stock and portion of the roadbed of the Nantucket & Siasconset Railroad, which crosses for seven miles the moors of Nantucket Island. The service of the narrow gauge road is most unique, for the train stops on signal at any point between Nantucket and 'Sconset, affording special service for parties desiring to picnic or gather flowers. Quaint Nantucket has many charms for the individual who longs to be rid of city din and the complex activities of life. The sprightly auto is unknown there; neither do the puffs from the diminutive locomotive or merry jingle of the little bell annoy, but really add a touch of cheer, as the harmless train goes by. Nantucket town has splendid carriage drives, and a grand bathing beach. Captain Andrews is always ready for an eight-mile trip to take out parties for fishing—where the fish are, in truth.

At 'Sconset the visitor is charmed while walking through the narrow streets. Many old homes of whalemen survive, and from the ancient roofs can be seen "look-outs," where longing ones stood for hours, awaiting the mariner's return.

NEW ENGLAND NARROW GAUGE ROAD.

One of the important Marconi wireless stations is erected here, at which it was my privilege to hear the twitter, between dots and dashes, inside the plant—now closed, owing to Governmental authority stepping in, due to the iniquitous European war.

The boat ride from New Bedford, or Woods Hole, to the Island is a delightful one; and some day some reader in RAILWAY AND LOCOMOTIVE ENGINEERING will say: "I'll just run down to that quaint New England colony."

WM. DURANT.

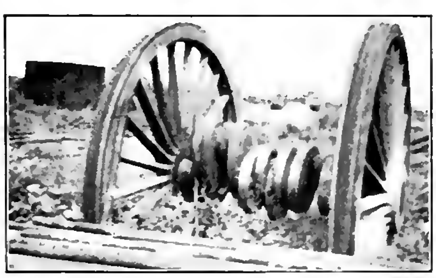
Somerville, Mass.

Locomotive—James Toleman.

EDITOR:

Probably there is among your archives of the "World's Columbian Exposition," which was held in Chicago during 1893, a photo of the locomotive "James Toleman." This engine was exhibited by Messrs. Westwood & Winby, of London, England. I am enclosing you a few kodak pictures of all that now remains of that stately engine, which I recently found in a junk yard in the vicinity of Chicago.

The "James Toleman" was of a unique design, the boiler was oval, probably the first, and no doubt the last boiler built for a locomotive, of that type. There were two pairs of driving wheels, seven feet in diameter, a four-wheel truck, and a pair of trailers. There were two sets of cylinders, all high pressure, 16 x 24 inches. The front cylinders were set between the frames and actuated the front pair of drivers through the medium of a cranked axle. The second set were outside and connected to the rear drivers.

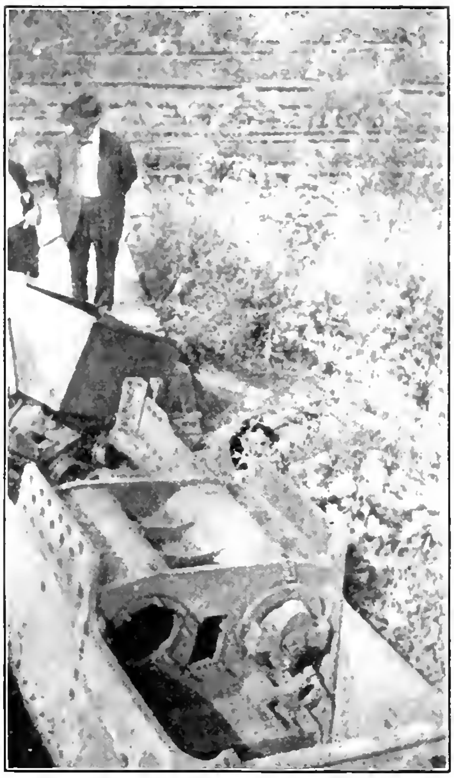


MAIN AXLE AND DRIVING WHEELS OF THE "JAMES TOLEMAN."

The inside cylinders had the Stephenson link valve gear. The outside set had a Joy valve gear. The reverse and cut-off of both engines was regulated by one reach-rod, equipped with the screw arrangement for manipulation, as is the case on all British engines.

The engine was built by the Hawthorne Leslie Co., of New Castle on Tyne, England, to the designs of Mr. Fred. Winby. No finer material or workmanship was ever used on a locomotive than was found on the "James Toleman." To fully describe the different metals employed, and the beauty of the workmanship, would make a fair-sized book: suffice it to say that both were of the highest quality the skill of man could produce.

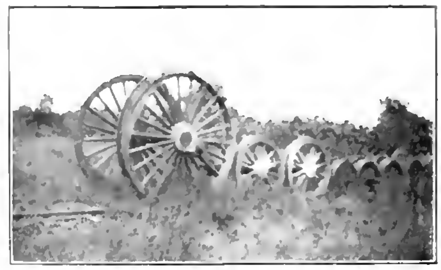
It was the writer's privilege to get quite well acquainted with Mr. Winby during the World's Fair period; it was not only a privilege but a pleasure. He was very enthusiastic over his engine, and expected great results from its performance, when put into actual service—expectations, I regret to say, that were not realized. The last time I saw Mr. Winby was in Milwaukee, Wis., December, 1893. The engine was tried out on the C. M. & St. P. Ry. After many trials, the engine did not prove a success. I am told it remained in Milwaukee for several years, and finally found its way to the junk yard, where it was broken up, and now all that remains are the few pieces, shown in the photos.



CYLINDERS OF THE "JAMES TOLEMAN."

I might add in closing, that the foreman of the junk yard told me that in a rather long career of tearing old machinery apart, he never found such a difficult job as that of dismembering the "James Toleman." To use his own phrase, "That thing was built to last forever. I had to use dynamite to bust it up."

L. G.



WHEELS OF THE "JAMES TOLEMAN."

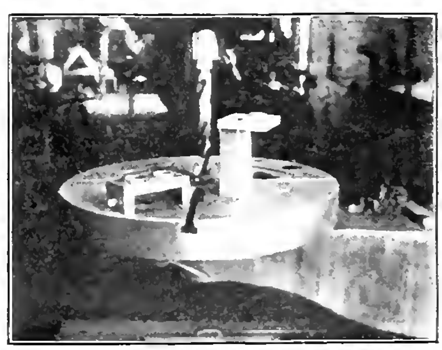
Lay-Out and Drill Templets for Wedge Nut and Bolt Holes.

By F. W. BENTLEY, JR.

The use of laying out templets is something which if given careful attention will cut down a great deal of skilled labor shop expense which may be used to advantage elsewhere. There are not a few templets which the writer has observed in use in railway shops which paid for the expense of their manufacture on one or two jobs.

The accompanying sketches are descriptive of a wedge nut and bolt hole templet which is very practical for this phase of the machining operation on them. The wedge nut hole templet is simply laid over the wedge flush with its end and tightened by means of the set screw. The $1\frac{1}{2}$ in. drill is then run down through the case-hardened guide bushings.

The bolt hole templet has a shank the same taper as the frame jaw of the locomotive, and is bolted to the wedge by means of the bolts holding it to the vertical angle iron on the bed of the press. After drilling down the 15/16 in. hole through the wedge nut holes, the wedge nut is driven in and a center started on it with the drill of the above size. The drill is then removed and a 25/32 in. one substituted for going through the nut to tap to $\frac{7}{8}$ in. to take the bolt.

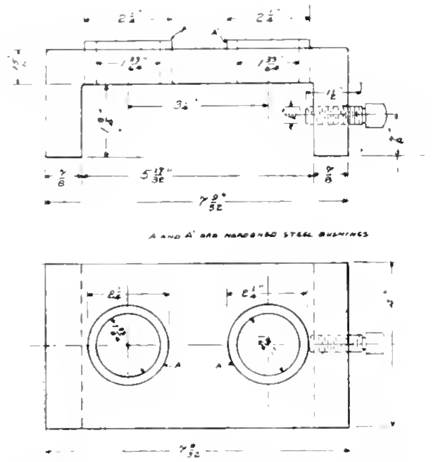


WEDGE NUT AND BOLT HOLE TEMPLET.

The hardened guide bushings eliminate the necessity of throwing drills to get them with the lay-out marks, and it is

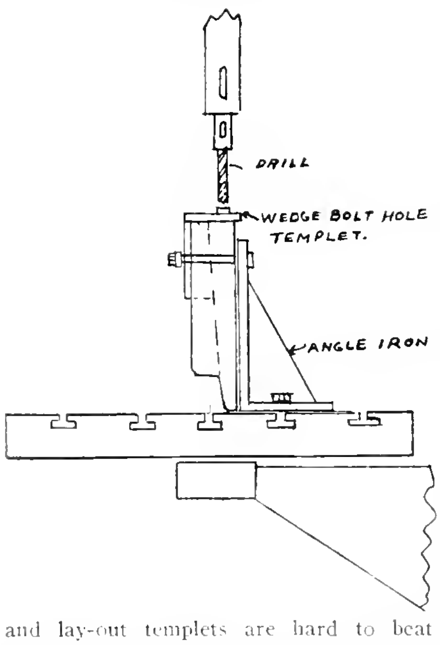
almost impossible for the jigs to be applied wrong.

All work in connection with the jigs



WEDGE NUT HOLE TEMPLET, WROUGHT OR CAST IRON.

can be done by any ordinary drill press man, as there is no complicated laying-out required in their use. From the standpoints of economy and facility in connection with wedge work the drill



and lay-out templets are hard to beat and there is hardly a shop of any size in which they would not soon repay the expense of their manufacture.

The Men Who Run Our Locomotives.

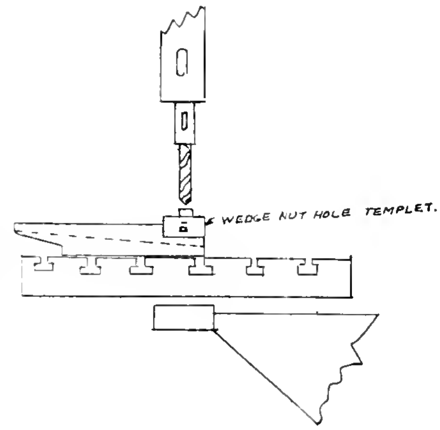
No class of workmen employed by railway companies exert so much influence on the operating expenses of railways as that performed by locomotive engineers and firemen. On that account the character and skill of enginemen have always received close attention from railway officials. In the days when locomotives were small and trains light, it was not of great consequence having enginemen who were constantly trying to do the best with the machines they were operating, but of late years when the 100-tons locomotive and over have come into popularity, it is easy for enginemen to waste or save on each trip much more than the amount of their wages. On that account it has become the regular practice for well managed railway companies to subject their enginemen to exacting examinations to demonstrate their knowledge of the locomotive and the most approved methods of its operation.

The locomotive engine which reaches nearest perfection is one which performs the greatest amount of work at the least expense for fuel, lubricants, wear and tear of machinery, and of the track traversed; the nearest approach to perfection in a locomotive engineer is the man who can operate the engine so as to develop its greatest capabilities at the least cost. On the railroads throughout this great continent, employing about one hundred thousand engineers and firemen, all sorts of men are found filling the positions, but the roads possessed of the fittest for the work required are those that operate their trains at the least expense.

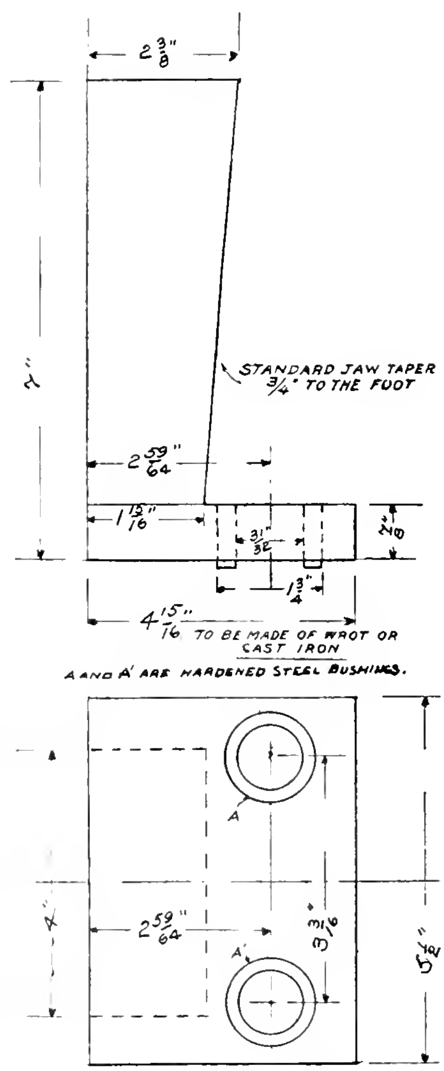
Poets are said to be born, not made. The same may be said of real engineers. One man may have charge of a locomotive for only a few months and yet in that short time acquire thorough knowledge of his business, displaying sagacity resembling instinct concerning the treatment necessary to secure the best performance of his engine. Another man, who appears equally intelligent in matters outside of locomotive engineering, never develops a thorough understanding of the machine he is engaged in handling.

There are few lines of work wherein the faculty of concentrating the mind upon the work on hand is so valuable as that of running a locomotive. A man may be highly intelligent and well endowed with general knowledge, but on a locomotive he will make a failure unless his whole attention while in the cab is devoted to the duties of taking the engine and train over the division safely on time. Every locomotive, and in fact every machine, possesses rhythms of its own which the operator ought to familiarize himself with. There is the rhythm which means sound condition with every part in proper working order. That produces notes of harmony with no discord, and it ought to be the voice of every engine in proper condition. When connections become loose with resulting pounding, when rubbing surfaces jar, and the running gear give forth strange sounds, the engine is falling into worn out condition every note of which should be familiar to the ear of the engineer, enabling him to report on what is needed.

The man who thinks that the noises made by an engine are tumults unworthy of attention will not remain in charge many days before he encounters machinery failure that will rightly be laid upon the engineer. The engineer who permits outside hobbies or interests



to absorb much of his time and attention while running a locomotive will fall into many scraps. Robert Burt was consid-



WEDGE BOLT HOLE TEMPLET.

ered one of the best behaved engineers on the Prairie Central, but he was often in trouble through misplaced piety. One

morning he arrived at the engine house and remarked: "Had a splendid run. All the way I could hear my engine singing bless the Lord." "I know what was the matter mit your engine," remarked the German hostler; "her valves vas out."

A man who possesses the natural gifts necessary for the making of a good engineer will advance more rapidly in acquiring mastery of the business than does one whom nature intended for a stone-breaker. But there is no royal road to the knowledge and skill required for making a first-class engineer. The capability of handling an engine can be acquired by a few months practice. If a robust young man hired as a fireman fails to dispose of the fuel in three or four weeks so that the engine will steam freely, he is never likely to become a first-class fireman. Opening the throttle valve, and moving the reverse lever to suit the work the engine is expected to perform, require no skill worth considering; there is no great accomplishment in packing a cellar, tighten a loose nut or to keep connection properly adjusted; but the accumulation of practical knowledge which enables an engineer to meet every trouble or emergency with calmness, promptitude and efficiency is obtained only by years of experience on the footboard, and by assiduous observation while there.

In Europe and in many other countries the locomotive engine driver forms a life class from which no promotion is expected or looked for. It has always been different upon the American continent where the experience in the engine cab has been looked upon as a training for a higher position. Not a few of our higher railroad officials received the first part of their training on the footboard, and some enginemen have risen to grace the highest ranks of the mechanical and social world. The pioneer engines, which demonstrated the successful working of locomotive power, were run by some of the most accomplished mechanical engineers in the country. As an engine adapted to the work it has to perform, the American locomotive is recognized to have always kept ahead of its rivals in other parts of the world. No inconsiderable part of this superiority was in the early days due to the fact that nearly all the master mechanics who controlled the designing of the locomotives had experience in running them, and thereby understood exactly the qualities most needed in construction.

The safe and punctual operation of our railways has always depended to a great extent upon the discriminating care and judgment of the engineer. Every year sees the introduction of new appliances for the purpose of increasing the safety of train operating; but no automatic appliances will ever enable a man to run a locomotive safely if he is deficient in judgment, care and intelligence. The increasing amount of train mechanism every year imposes new responsibilities upon the locomotive enginemen. The tendency is to require the engineer to understand, not only anything about the locomotive from valve motion to steam superheating; but every detail of air-brake mechanism, train signals, heating apparatus, lighting appliances and every other train attachment. If a modern locomotive engineer is capable of fulfilling the latest requirements he holds on a train a position analogous to that of the chief engineer of an ocean going steamer.

One of our most efficient railroad commissioners, writing on the subject of "Railway Accidents," says: "In discussing and comparing the appliances used in the practical operating of railways in different countries, there is one element which can never be left out of the account. The intelligence, quickness of perception and capacity for taking care of themselves—that combination of qualities which, taken together, constitute individuality and adaptation to circumstances—vary greatly among the railway employes of different countries. The American locomotive engineer, as he is called, is especially gifted for fitness. He can be relied on to take care of himself and his train under circumstances which in other countries would be thought to insure disaster."

The apprenticeship which a man passes through to learn the art of locomotive engine running is to serve for years performing the duties of locomotive fireman. Attempts have been made repeatedly to train men to the work of engine running without going through the toil and hardship of performing firemen's duties, but they have never been satisfactory.

The method usually pursued in training men to be good engineers is to select young men of good character for the position of firemen, and to provide the opportunity for the young man to learn the rudiments of his business, which is to fire in such a way that there will be no lack of steam, and no superfluity to be wasted through the safety valves.

The policy and practice of the Erie and other first class railroads is to employ only as firemen men who will in time become competent engineers. This requires that a man should have at least a common school education, good habits and be in good physical condition. He should be of active habits, with good reasoning faculties, and of sound judgment.

A writer who has enjoyed personal experience in the training of firemen writes: "A man may become a good and skillful firemen without having any scientific knowledge; there is one mental attribute which he must possess or he will not succeed, that is, good judgment. Good judgment is an aid to success in every calling, but it seems essential in a locomotive fireman, because he is left to his own resources almost entirely after learning in a crude way how fuel should be supplied to a firebox. In the course of a run over most divisions a locomotive pulling a heavy train has to meet so many varying conditions in the demand for steam that the successful fireman must exercise very good judgment to have the fire just right for the demand to be put upon it. Some of the most intelligent men the writer has observed in the cab have never become first class firemen because they lacked good judgment."

As an aid to the instruction of firemen his employers usually place in his hands a code of questions relating to his duties, and it is expected that the preparation necessary to correctly consider these questions will be undertaken by study which will fit him for the work that he is expected to perform, both as a fireman and as an engineer.

When a man is first employed as a fireman he will be given the questions on which he will be examined at the end of the first year. Having passed this examination successfully he will then be given the questions for the following year. Having passed this second examination satisfactorily he will be given the third and final set of examination questions on which he will be examined before being promoted to the standing of engineer. All these examinations will be both written and oral. At any of these examinations, if the candidate fails to pass 80 per cent. of the questions asked, another trial not less than two months, and not more than six months later, will be given for him to pass the same examination. If then he fails to pass by 80 per cent. he will be dropped from the service.

The persons who fail in these examinations are generally men who put off study until the day of examination is approaching. The sensible man begins studying the questions as soon as he receives them.

It is not expected that a fireman will pass these examinations without assistance, and in order that he may understand the construction and use of the various appliances properly, most of the railroad companies have a school of instruction to which all employes are invited. When the fireman is in doubt about the answer to any question, he is expected to consult a master mechanic, road foreman of engines, air brake inspector or any other personage in the employ of the company likely to possess the information required.

In regard to breakdowns, it is advised that the candidate carefully examine every breakdown or disabled engine that comes within his notice. Note where breakages have occurred and in what

manner the work of blocking has been done. It is good practice to observe how engineers deal with breakdowns no matter on what engine they may have happened.

Giving correct answers to the questions constituting these examinations does not constitute the sole recommendation of the fireman for promotion. The work he has done during the year as compared with other firemen in the same class of service will be taken into consideration. His record as to the use of coal, supplies and attention to duty is considered important.

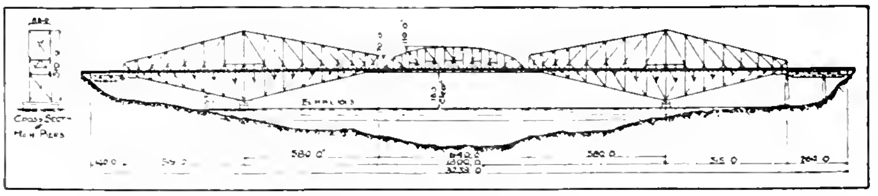
Firemen who have gone through no shop experience will gain useful information by passing all the time they can spare watching repair shop and roundhouse operations. Every detail of roundhouse work should be closely observed: the various parts of the great machine they are learning to manage should be studied in detail. No operation of repairs is too trifling not to merit strict attention. When the machinists are examining piston packing, facing valves, reducing rod brasses, lining down wedges or such work, the ambitious novice will by close watching of the operations obtain knowledge of the most useful kind. Repairing air pumps, injectors, lubricators, safety valves and other parts is interesting work full of instructive points that may prove useful on the road. The rough work of the men who change truck wheels, put new brasses in oil boxes and replace broken springs, is well worthy of close attention, for it is just such work that enginemen are frequently called upon to perform on the road in cases of accident. To obtain a thorough insight into the working of the locomotive no detail of its construction is too trifling for attention. The unison of the aggregate machine depends upon the harmonious adjustment of its various parts. Unless an engineer understands the connection of the details he is never likely to be skillful in detecting derangements.

Jay Johnson was a young engineer belonging to the numerous class who despise studies of all sorts, and imagine that they can learn by a sort of intuition that needs no labor. Jay started out with an engine that had a leading truck with oil cellars different from those he had been accustomed to. One of the oil boxes got hot, and Jay started to take down the oil cellar, but he wrestled with the job for half an hour, and the cellar continued as firmly in place as a driving wheel center. The conductor of the train sauntered along, and happening to understand the design of that particular oil cellar helped the engineer to take it down. The story soon found its way to headquarters with additions, and Jay Johnson was assigned back to the firemen's side, with the opportunity and recommendation to study the peculiarity of oil boxes and other things.

The New Quebec Bridge.

According to the Canadian Department of Railways and Canals, work on the new Quebec bridge, which was contracted to be finished on December 31, 1915, is making satisfactory progress. The contract price is 9 2-10 cents a ton and will aggregate about $8,650,000, a saving of about $2,600,000 having been effected by the elimination of the highways for vehicular traffic contemplated in the original design.

The bridge when constructed will have a total length of 3,228 ft., or about 3-5 of a mile. The center span will be 1,800 ft. long, the length of the suspended portion of it will be 640 ft. This span will, for a length of 760 ft. over the channel of the river, have a height of 150 ft. between its lower members and the high water level of the river. The two cantilever arms will each be 580 ft. long. The width of the bridge between trusses will be 88 ft. The bridge will comprise a double-track railway, and two sidewalks for foot passengers.



PROFILE VIEW OF THE NEW QUEBEC BRIDGE.

Intra-Mural Railway at the Panama-Pacific International Exposition.

Of the several means to be taken to eliminate the bugaboo of leg-weariness from the grounds of the Panama-Pacific International Exposition during 1915, the most elaborate and effective will be the little intra-mural steam railway, with its five miles of steel track, work on which was begun on October 1. With its eight or ten modern Pacific type of engines, 17 ft. in length, each weighing 12 tons equipped with air brakes, standard automobile couplers, electric headlight and six drive wheels, each little giant hauling a train of ten miniature passenger coaches, and running on a regular schedule on a double-track system, the Exposition Marina Railway puts the finishing touch to the metropolitan appearance and business facilities of the Aladdin City.

Despite the extremely narrow gauge of the track, only 19 inches, each of the coaches, with a width of 42 inches and a length of 20 feet, will contain ten transverse seats, will seat twenty passengers. With ten coaches to each train and eight trains in operation, sixteen hundred people can be put in motion at once. Conforming to city speed regulations, the trains will make only about ten miles an hour between stations, of which there will be seven, including three terminals, elaborately fitted up with train sheds, elevated platform and turntables.

Steel Railroad Ties.

Steel railroad ties are being extensively used in Switzerland. At present 65 per cent. of the Federal Railways employ them. They have the form or profile of a trough into which shape they are rolled at the mills. The ends are bent down, the profile of the trough being thus closed. Holes are provided for the attachment of the rails by means of clamp plates and no tieplates are used under the rails. The weight of the trough profile is 55.47 lbs. per meter and the ties complete, with holes bored, weigh 159.84 lbs. each. According to the requirements of the Federal Railways the steel in these ties must have a tensile strength of about 59,000 to 64,000 lbs. per sq. in. and an entire trough piece shall admit of being bent together on its back without showing any breaking fissures.

The San Francisco Fair

An army of men is now busily engaged in completing the landscaping of the Panama-Pacific International Exposition. The era of construction on the exhibit palaces has passed and the installation of exhibits has begun. Within a few weeks thousands of exhibitors, with their army of attendants, will be installing their displays. Altogether more than 70,000 tons of exhibits will be brought to the grounds, the freight charges on which, it is estimated, will entail an outlay of more than $4,000,000. The traffic department of the exposition estimates that more than 1,000,000 will cross the Rocky Mountains to the Pacific coast next year.

We are continually assured that it is unwise to trust certain people to free action, hence the tendency to pass laws for regulating every conceivable action of men and women. Cromwell was a man who understood human nature and how far the restraint of law should be popularly applied. One of his dictums was, "It will be found an unjust and unwise jealousy to deprive a man of his natural liberty upon a supposition that he will abuse it."

Catechism of Railroad Operation

NEW SERIES.

Third Year's Examination.

(*Continued from page 365, Oct., 1914.*)

Q. 108.—What would you do if body of piston valve or its heads were broken?

A.—Put blind gasket in joint of live steam pipe.

Another way.—Cut large round stick of wood that would fill valve chamber, put piece of sheet iron around it to keep steam from cutting it away, and put it in valve chamber in place of valve, then in either case it would be necessary to disconnect valve rod and provide for free circulation of air in cylinder and for lubrication.

Q. 109.—How would you test for broken packing rings in an inside admission piston valve?

A.—In practically the same way as with a slide valve, but as the rings determine the steam and exhaust edges of the valve you may be able to tell which ring is defective by placing the engine on the quarter on side to be tested, and the reverse lever in center of rack, open the cylinder cocks, admit steam; if you get a blow through to the exhaust, at end where steam will show at cylinder cock both rings are defective; if you get no blow with valve on center of seat, move the lever so that steam ring will open admission port a little, and if you get a blow through to the exhaust it will indicate that the exhaust ring is defective at end of valve where steam port is opened, and steam is showing at the cylinder cock; if you get no blow, move the lever so that the valve will be moved to position where exhaust ring will uncover exhaust edge of admission port; if you get a blow through to the exhaust in that position it indicates that the steam ring at that end of valve is defective; testing both ends of valve in this way you can locate the rings which are defective.

Note.—The broken steam rings are generally located when valve is placed on the center of seat, and steam is admitted to chest, because with cylinder cocks open the steam will show at end of cylinder where steam ring is defective. The test merely proves it to you.

Q. 110.—How can you locate a slipped eccentric or blade quickly, and know whether it is the back up motion eccentric or the forward motion which is gone wrong?

A.—By knowing that with the reverse lever placed in either corner of the rack one eccentric practically controls the valve movements, but between the corners both eccentrics have an influence on the valve, and that the exhausts occur when crank pins are crossing the centers; if engine goes lame while running along on account of slipped eccentric or rod, you may move the lever towards the corner, and if valve motion squares up as the goahead eccentric is placed more in control of the valve it indicates that the goahead eccentric is all right, and by pulling the lever up toward the center you will place the backup eccentric more in control, and the engine will get lamer the nearer the center you get, the lever indicating that the backup eccentric is wrong, but if she gets lamer as you drop the lever down, placing the goahead in control, it shows that the goahead is wrong, and as you hook her up toward center she will square up; watching the crank you can locate which side has the uneven exhaust.

Note.—By placing the engine on the dead center on the defective side, and having the reverse lever in center of rack, you can tell whether the blade has slipped too long or too short, because with the engine in this position when eccentrics are right the link will stand straight up or perpendicular, so by noting which way the defective blade causes the link to incline from the perpendicular position you will know whether to shorten or lengthen the blade.

Q. 111.—How would you set a slipped eccentric?

A.—Place the engine on the dead center on disabled side, place the reverse lever in the extreme corner of quadrant which will place the good eccentric in control of the valve, mark the valve stem flush with the face of the gland, place the reverse lever in the opposite extreme corner of quadrant, go under the engine and turn slipped eccentric on axle until the mark on valve stem comes back flush with the gland, being sure to have the throw (web) of eccentric on the opposite side of the main pin from the one that is solid on the axle.

Another way.—Knowing that the left main pin is one-fourth of a turn back of the right main pin (if a right lead engine) and on the left lead engine the left main pin is one-fourth of a turn ahead of the right main pin, and that the eccentrics bear the same relative position to their respective main pins: no matter what the position, engine is standing in, you may go under the engine and turn the slipped eccentric on the axle until the throw (web) is one-fourth of a turn ahead or back of the corresponding eccentric on the opposite side of engine, as the construction of engine may require, and the eccentric will be approximately right. This is called the quartering the axle method.

Another way.—Knowing that with the engine standing on the dead center and reverse lever in either extreme corner of rack, the admission port at end of cylinder where piston rests will be open the amount of lead, and that with indirect motion and the outside admission valve or the direct motion and the inside admission valve, the throw or web of the go-ahead eccentric follows the main pin at right angles less the lap and lead angle of advance toward the pin, and the back-up eccentric is ahead of the pin at the same angle. Know also that the direct motion for outside admission valve and the indirect motion for the inside admission valve, have the go-ahead eccentric leading the main pin at right angles plus the lap and lead angle of advance from the pin, and the back-up eccentric is following the pin at a corresponding angle. With this knowledge you will place the engine on the dead center on disabled side, with reverse lever in corner of rack which will place the slipped eccentric in control of the valve, go under the engine and turn the disabled eccentric until the throw (web) is at right angles to main pin, being sure to have it on opposite side of main pin from web of one that is solid on the axle, then with cylinder cocks open and a little steam admitted to chest, incline the eccentric towards or from the main pin, as the construction of the valve motion requires, until a little steam shows at the cylinder cock at end of cylinder where the piston rests, secure it there and proceed.

Q. 112.—What is a right lead engine?

A.—A right lead engine is one having the right main pin one-fourth of a turn ahead of the left main pin.

Electrification of a Long Tunnel.

The 5½-mile double-track Canadian-Pacific tunnel through the Selkirk Mountains, which will be the longest in the Western Hemisphere, is to be electrified. This tunnel will shorten the main line by 6 miles, will eliminate 5½ miles of snowsheds, reduce the peak of grade 513 ft., and do away with all but 6 miles of 2.2 per cent. grade. On its entire system of more than 12,000 miles in Canada it will have but a dozen miles of 2.2 gradient. The latest systems of electrification are to be used in operating the trains through this tunnel.

4-4-0 Type of Locomotive for the United Railways of Yucatan

The accompanying illustration represents a modern example of a type of locomotive which formerly worked the greater part of the through-express traffic in this country. The engine shown has recently been built by The Baldwin Locomotive Works for the United Railways, of Yucatan. It is of the American type, equipped for burning wood. The gauge is standard, and as the line is laid with light rails it was important to keep the weight as low as consistent with the required strength. The locomotive exerts a tractive force of 14,300 lbs.

The boiler is of the extended wagon-top type, with a deep firebox placed between the driving-axles. The grate is composed of plain bars and dead plates. The smoke-box is short, and it contains a low double nozzle and adjustable petticoat pipe. The stack is of the Radley and Hunter pattern, a design which has proved unusually successful on wood-burning locomotives. The sparks are given a rotary motion by means of a conical deflector placed within the stack casing, and are broken up and extinguished before they reach the atmosphere.

This locomotive is equipped with balanced slide valves which are driven by the Stephenson link motion. The objections to the use of this gear, which apply in the case of locomotives having driving-wheels closely grouped, are not applicable in the present instance, as there is ample room between the cylinders and main wheels to render the motion work easily accessible.

The tender is fitted with a wood-rack of sufficient height to enable 2½ cords of fuel to be carried. The tender frame is built of 8-inch channels, and the trucks are of the arch-bar type, with steel bolsters and chilled cast-iron wheels. The engine truck wheels are steel tired.

This locomotive is equipped with automatic air brakes, M. C. B. couplers arranged to fold back, air sanders and electric headlight and cab lights. Provision has been made for applying a speed recorder after the engine is received by the purchasing company.

The following are the general dimensions of this type of locomotive:

Gauge, 4 ft., 8½ ins.; cylinders, 17 ins. by 24 ins.; valves, balanced slide.

Boiler—Type, wagon-top; diameter, 54 ins.; thickness of sheets, ½ in. by 9/16 in.; working pressure, 160 lbs.; fuel, wood; staying, radial.

Fire Box—Material, steel; length, 71½ ins.; width, 33⅛ ins.; depth, front, 76½ ins.; depth, back, 75½ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, 5/16 in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 4 ins.; sides, 3 ins.; back, 3 ins.

Tubes—Material, iron; thickness, No. 12 W. G.; number, 234; diameter, 2 ins.; length, 10 ft. 10½ ins.

Heating Surface—Fire box, 127 sq. ft.; tubes, 1322 sq. ft.; total, 1449 sq. ft.; grate area, 16.7 sq. ft.

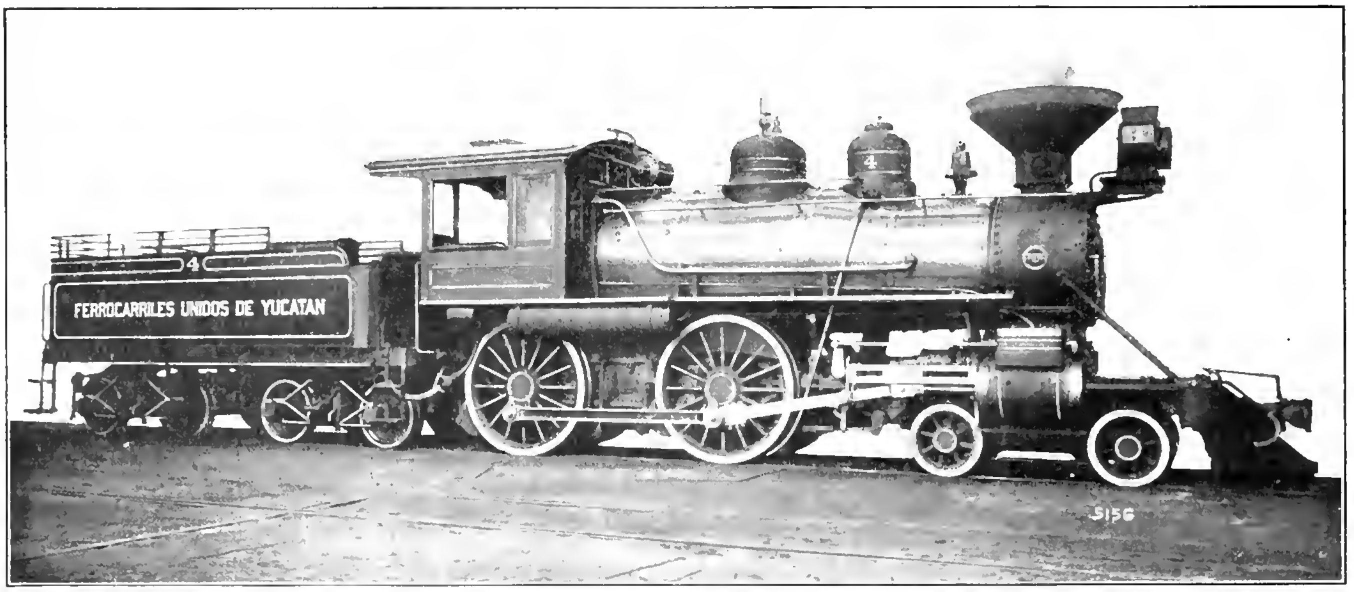
Driving Wheels—Diameter, outside, 66 ins.; diameter, center, 60 ins.; journals, main and others 7½ ins. by 8½ ins.

Engine Truck Wheels—Diameter, front, 30 ins.; journals, 5 ins. by 8 ins.

Wheel Base—Driving, 8 ft. 6 ins.; rigid, 8 ft. 6 ins.; total engine, 22 ft. 6 ins.; total engine and tender 45 ft. 7½ ins.

Weight—On driving wheels, 59,550 lbs.; on truck, front, 36,900 lbs.; total engine, 96,450 lbs.; total engine and tender, 160,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 3¾ ins. by 7 ins.; tank capacity, 3,000 gals.; fuel capacity, 2½ cords; service, passenger and freight.



EIGHT-WHEEL TYPE LOCOMOTIVE FOR THE UNITED RAILWAYS OF YUCATAN.

F. W. Blake, Gen. Manager. Baldwin Locomotive Works, Builders.

Couplings for Injectors.

The Committee of the Railway Master Mechanics' Association chosen to investigate and report on the "Dimensions for Flange and Screw Couplings for Injectors," appear determined to perform the investigation thoroughly, for Mr. M. H. Haig, the chairman, has sent out a circular which calls for answers to 44 questions. These questions are very comprehensive, and embrace all sorts of useful information about couplings for injectors.

Brazilian Railway Development.

A recent statement by Senor Hermes da Fonseca, the president of Brazil, says that the railway system of Brazil was increased in 1913 by 1,431 miles, bringing the total up to 15,280 miles. Of this total 2,188 miles are operated by the federal government, 5,728 miles are leased by it to individuals, 3,454 miles have been "conceded" by the federal government to private enterprise and there are 3,903 miles which have been conceded by the different states.

Large Railway Contract.

Probably one of the largest contracts ever secured by Chilean manufacturers was recorded on July 6, when the Government placed a home order for railway equipment to the value of 40,000,000 pesos ($8,240,000).

Importance of Coal Economy

By ANGUS SINCLAIR, D.E.

FIRST ARTICLE.

IMPORTANCE OF COAL ECONOMY.

The coal account of the locomotive department constitutes an important outlay in railroad expenditures. It makes a heavy drain upon every railroad in the country. We are told that the man who makes two blades of grass grow where one blade used to grow is a benefactor of the human race. As the quantity of coal provided for the use of mankind is limited, and the means of cultivating a fresh supply are not apparent, it would seem that the man who makes one pound of coal do the work that has generally called for the consumption of one and a half pounds of coal, is worthy of a share of the admiration accorded to the industrious agriculturist. There are locomotives in the country where the coal consumed in the generation of steam is used as economically as knowledge and skill can effect, but these are very exceptional cases. Much has been said and written of late years about proper methods of firing, founded on the correct conception of the laws that regulate combustion, but the great mass of our locomotives continue to be fired in a way that violates all nature's laws, and a senseless waste of coal is the result. The opportunities for firemen mending their ways and earning the distinction of being public benefactors, to say nothing of being better worthy of employment, are innumerable.

WHERE THE RESPONSIBILITY FOR THE BAD FIRING RESTS.

Unfortunately, ignorance of the laws relating to the combustion of coal is not confined to firemen and men of similar rank. The higher railroad officers, whose duty it is to supervise the work done by enginemen, are in too many instances unable to detect shortcomings of their subordinates through want of technical knowledge. If these men would devote more time to studying the principles of combustion, the knowledge gained would redound to the advantage of railroad companies.

VALUE OF CHEMICAL KNOWLEDGE.

Practical men are, as a rule, too ready to underrate the value of information that has to be obtained by study of books; but a knowledge of the principles of combustion cannot well be reached in any other way, for life is too short for men engaged in other pursuits to acquire abstruse chemical knowledge by original investigation. The burning of bituminous coal represents a most complex chemical phenomenon, and considerable acquaintance with the laws that regulate the combination of gases is necessary before a man can follow the process intelligently. And unless he understands the nature of combustion he is not likely to be very successful in arranging the details of furnaces where coal has to be burned. A master mechanic who does not understand the laws relating to combustion is like a physician who is ignorant of the laws of hygiene. Both men may follow their business and make a living at it, but neither is a credit to his profession.

WEAK OBSTACLES DETER STUDY

Many men are deterred from entering upon the study of chemistry relating to combustion on account of the formidable names of gases, and the strange chemical terms that meet them at the start. A very little perseverance and courage will vanquish that lion in the path, which proves a very weak obstacle when firmly grappled with. After once engaging in it, every hour devoted to study will bring ample compensation in the shape of extended knowledge. Without a knowledge of how the processes of combustion are carried on, a master mechanic is not only deficient in information directly relating to his constructive business, but he is continually liable to become the victim of patent furnace quacks, who often succeed in imposing upon railroads appliances recommended to promote combustion, which in operation act contrary to nature's processes.

COMBUSTION OF MATTER.

The chemical investigations of many scientists have shown that all substances found in the earth, the air and the sea, whether they are of mineral, of vegetable or of animal origin, may be divided into two great classes—simple bodies or elements, substances out of which nothing different can be got; and compound bodies formed from two or more of these elements. There are about sixty-five elements that have been so far identified. Some of the elements are gaseous, some are liquid, and others are found in a solid condition, at ordinary temperature.

Only fourteen of the elements are of common occurrence, and of these the great mass of the earth with its atmosphere and water are composed. The remainder occur only in comparatively small quantities, and fully one-third of the whole number are so rare as not to admit of any useful application.

Chemists usually designate the elements by their physical appearance, as metallic and non-metallic. A few of the best known non-metallic elements are oxygen, hydrogen, nitrogen, carbon, sulphur and phosphorus; a few of the most familiar metallic elements are iron, copper, zinc, gold, silver, tin, lead and mercury.

CHEMICAL COMBINATIONS.

The elementary substances unite together to form compound bodies which are generally very unlike any of the elements they came from. Thus, oxygen and hydrogen unite to form water. All chemical combinations take place in fixed quantities, the water, for instance being formed by 8 parts by weight of oxygen combining with 1 part by weight of hydrogen.

The cause of chemical combination is a matter of pure speculation, but it is supposed to occur through the agency of an attractive force, acting only between the atoms of dissimilar substances, and only at insensible distances. This force is spoken of as a chemical affinity.

ELEMENTS IN COMBUSTION.

The elements which perform the principle operation in combustion are oxygen and carbon. Carbon is the combustible, and oxygen is a supporter of combustion. To call one of the elements a combustible and the other a supporter of combustion is not chemically correct, but it is a convenient way to designate them in describing furnace combustion. Carbon is the principle element found in trees and in all the woody fiber, and it has a strong affinity for oxygen at certain high temperatures. It is supposed that the high temperature is necessary to enable the atoms of oxygen and carbon to get close enough to come under the influence of the attractive forces. Wood may remain immersed in oxygen gas for years, and there will be no trace of chemical action; but raise the temperature to the point of ignition, and the two elements combine violently with evolution of great heat and light. Physicists have proved that heat results from the forcible impact of all bodies. It is believed that when elements combine, the atoms are put in rapid motion, hammering against each other, and that the heat, so useful to man, results from this clashing of atoms.

The element, hydrogen, so well known as a constituent of water, is also a combustible, and evolves great heat by combining with oxygen to form water. Hydrogen is not found free in nature, but it appears associated with carbon in numerous compounds, and as such makes valuable fuel.

SLOW AND RAPID COMBUSTION.

There are many other combustible elements besides those mentioned, such as sulphur and phosphorus, but none of them are ever likely to be used for the com-

mercial generation of heat. The rotting of wood and the rusting of iron are familiar instances of slow combustion, while the explosion of gunpowder, dynamite or gun-cotton, are cases of violently rapid combustion.

SOURCE OF OXYGEN USED IN COMBUSTION.

The oxygen required for furnace combustion is drawn from the atmospheric air which consists of oxygen and nitrogen in mechanical combination in the proportion of 8 to 26.8; or 1 pound of oxygen to 3.35 pounds of nitrogen, or by volume, 1 cubic foot of oxygen to 3.76 cubic feet of nitrogen. For every pound of oxygen employed in combustion 4.35 pounds of air are consumed; or, by measure, for every cubic foot of oxygen employed in combustion, 476 cubic feet of air are consumed. Nitrogen acts entirely as a dilutent to the oxygen with which it is associated, and it performs admirably conservative functions in nature; but for furnace combustion nitrogen is too freely represented and impedes economical fuel consumption in various ways. The large volume of this neutral gas accompanying the vital oxygen has to be heated to the highest furnace temperature, which represents considerable expenditure of fuel. Its presence also obstructs the direct contact of the oxygen and carbon, and leads part of the gases to pass off uncombined.

COAL.

At a remote period of time, the earth produced an enormous growth of forest trees and other kinds of vegetable matter, which, through convulsion on the surface of the globe got covered over with earth and rocks. Protected by this thick covering from the oxidizing influence of the atmosphere, and compressed by the superincumbent weight, the imprisoned matter solidified into coal. A process analogous to the original formation of the coal beds may now be in the vegetable deposits being made by rank tropical growth of plants, and in the peat formations common in various parts of the world. The lignite found in so many parts of the United States is a material apparently midway between wood and coal. Coal, being fossil wood that has gone through various physical changes induced by pressure and heat, contains all the elements found in the wood, besides numerous impurities drawn from the surroundings of its subterranean bed.

BITUMINOUS COAL.

The ordinary run of American bituminous coal contains from 50 to 75 per cent. of fixed carbon, which is the coke of the coal, and from 12 to 35 per cent. of volatile combustible, the latter being composed of substances resembling pitch, which burn with a lurid flame and supply the ingredients of coal gas. These inflammable substances are known as hydrocarbons, since they consist of different combinations of hydrogen and carbon. Mixed with all kinds of coal there are earthy and mineral impurities consisting of silica, alumina, iron, sulphur and saline matter, most of which do not burn, but remain behind as ashes.

ANTHRACITE COAL.

Anthracite coal differs from bituminous coal in this respect, that it consists principally of fixed carbon but with little volatile matter left in its composition. Good anthracite coal contains about 90 per cent. of pure carbon. The volatile substances are supposed to have been expelled by the action of heat.

The coal used for locomotive boilers in the United States ranges from low-grade bituminous coal that closely resembles lignite, up by imperceptible gradation to nearly pure carbon, as found in the best anthracite coal. Each different grade of coal ought to receive treatment in firing adapted to its chemical composition, but in most cases all kinds of coal are treated alike. In the succeeding articles I shall try to portray the effect of this promiscuous practice and suggest improvements.

Misery in Dunkirk.

The people of Dunkirk, N. Y., are noted for their antagonistic attitude toward the Brooks Locomotive Works, and they have repeatedly acted as if they would be pleased to see the locomotive building establishment removed to another locality. The town, or rather, its people, are feeling what the temporary closing of a great industrial establishment means to breadwinners. The Brooks Locomotive Works have been closed down for three months, and already the destitution in the town is almost without parallel. It is said that over two hundred gas meters have been taken out of houses owing to non-payment of rent and water turned off from suffering homes. The prospects of resuming work in these and other locomotive building establishments is still very uncertain.

Workmen's Compensation.

The New York State Workmen's Compensation Commission reports that the railroads are no longer opposing the application of the workmen's compensation law. They are insuring their risks, some having taken out policies in the State fund, while others have insured in the stock insurance companies. Still others insure their own risks. The distinction between intrastate and interstate employees in applying the law to the railroads is still an unsettled question, and decision in the matter will probably be held in abeyance until the first claims are filed. Four claims for compensation had been filed up to July 8. It was found that these were all death claims.

Courageous Railway Men.

Railway men have always been celebrated for readiness to offer themselves for special work where danger was involved. A call was recently made by the Canadian Government for volunteers to enlist in the army to aid the British forces and the response from railway men was so zealous that the number of men accepted had to be curtailed.

Here is a copy of an article that recently appeared in a British daily paper:

"Railwaymen generally have a warm place in the hearts of the public, and their response to the nation's call will enhance the high opinions already held by them. It is estimated that the great trunk companies have contributed at least twenty battalions to the forces. This number does not represent the total of those anxious to serve.

"Upon complaint being made to the *Daily Telegraph* that the companies were hindering men from joining the colors, a representative made inquiries and found that it had been necessary to stem the rush of recruits. The companies encouraged the men to serve, but the war office realized the danger of the working staffs of the home lines, which are essential for transport and other purposes, being seriously depleted.

"There are 2,500 recruits from the Great Eastern, 2,000 from the Great Central, and similar numbers from other systems, and the desire to serve showed no sign of abatement. The following notice of the Great Central will explain itself: 'Notice is hereby given that the war office has given instructions to recruiting officers not to accept railwaymen unless they produce a letter of assent from their superior officers.'"

Any man who can be spared obtains a letter at once, but the officials are compelled to maintain an efficient staff. Those who serve will be taken back when they have completed their military duties.

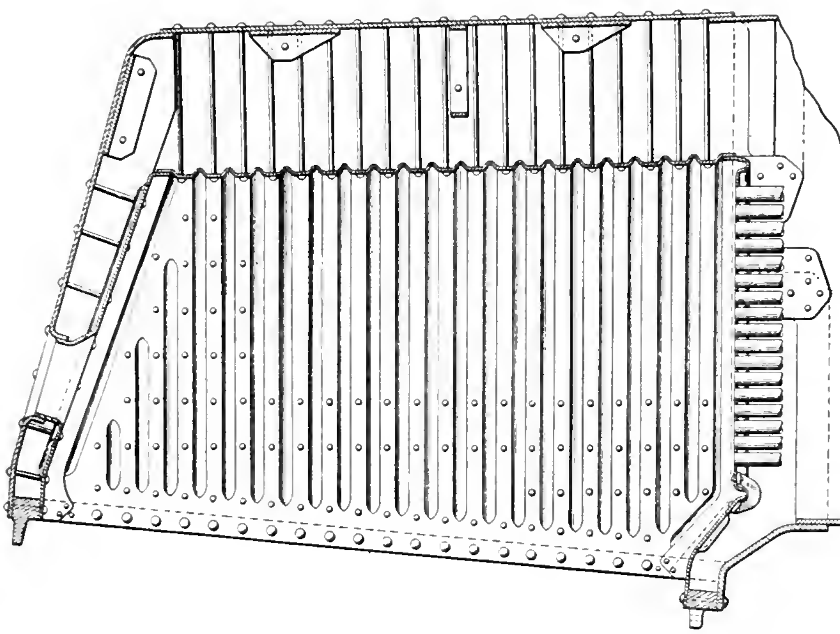
Nothing has been left undone by the Great Eastern. Positions are being kept open, a relief fund has been started for the dependents of those serving, and every care is being taken that the men shall not lose by their loyalty. But Mr. H. W. Thornton, the general manager, has had to issue a notice to the staff pointing out that it is essential for the welfare of the nation to maintain efficient railway staffs, and men must ascertain whether they can be spared before they enlist. The notice concludes as follows:

"The directors and officers of the company desire to express their best wishes to those of the company's employees who have already so nobly responded to the call of their country. At the same time, those whom circumstances force to remain in their present position should be regarded as performing a most important service to the nation."

Important Improvement in Locomotive Boilers

Repeated experiments have practically demonstrated that the important improvements on locomotive boilers perfected by William H. Wood, Media, Pa., are of value and when better business conditions prevail large installations may be expected. The latest improvements and variations of the original design by Mr. Wood show how carefully he has mastered the details of boiler construction, and undoubtedly if his abilities, which are remarkable, had been at work at an earlier date in locomotive practice, a much greater degree of economy in boiler construction and repair would have been established. The main objects in view have been the strengthening of the fire box structure in such a manner that the weakening or distortion of the tube sheets near the tubes is eliminated, while at the same time the flexibility of the fire box structure is materially increased without impairing its resistance to strains and stresses caused by the immense power exerted by the contraction and expansion of the boiler tubes in their relation to the boiler shell.

FIG. 1.



As is well-known it has been found that flat plates weaken and crack under the constant expansion and contraction of the tubes and cause breaking of the stay-bolts that hold the plates together. Flexible stay-bolts are an important improvement, and have to a large extent overcome the defects referred to, but the continued necessity for fixed stays has shown that they receive excessive pressure, and the plates become distorted at some points which the use of the flexible stay-bolts cannot entirely overcome on account of the movement being in the plates *not* in the bolts. Mr. Wood's invention comprises the construction of the firebox sheets of corrugated metal which combines an increased sectional area with greater strength and flexibility and incorporating in the firebox tube sheet a corrugation or groove portion which substantially encircles the tube area and merges into the throat sheet, the grooved portion being strengthened on lower part at suitable points with brackets which, added to the normal resistance of the sheet, serve to prevent buckling or distortion of the throat sheet under the weight of the tubes when the sheet is subjected to overheating.

FIG. 2.

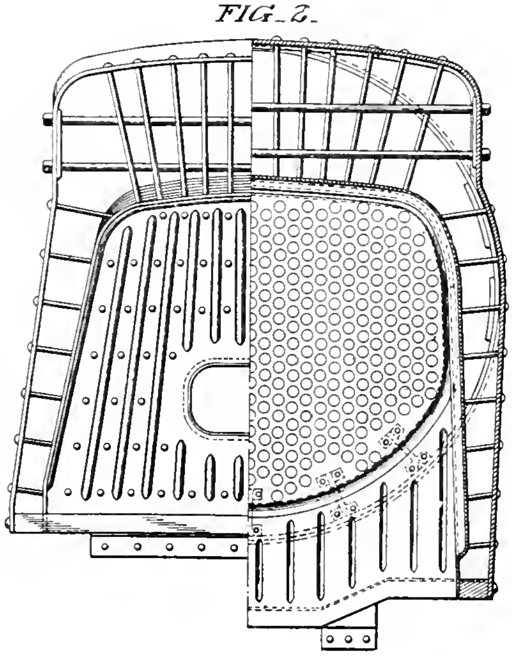


FIG. 3.

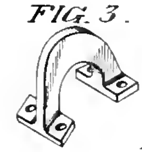


FIG. 5.

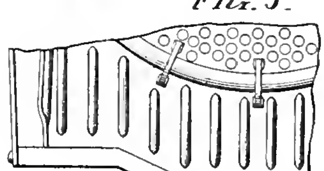
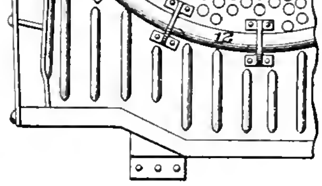


FIG. 4.



In the accompanying illustrations Fig. 1 represents a longitudinal elevation of a portion of a boiler embodying the invention. Fig. 2 represents an end elevation of the same, a portion being shown in an enlarged transverse section. Fig. 3 represents a perspective of one of the reinforcing devices. Fig. 4, represents an elevation of a portion of the throat tube plate showing one form of reinforcing device in operative position, and Fig 5 represents a similar elevation showing a modified type of reinforcing device.

The brackets alluded to are a new feature and admirably strengthen the lower part of the firebox tube plate. Only three of these brackets need be required, each taking one-third of the weight of the tubes at the point of deflection. They do not in any way interfere with the corrugation flexibility.

In the experiments already made with several of the corrugated boilers already in service every part of the corrugations remained perfect. There were no tube holes out of round, nor a bridge cracked, nor a crown raised, and the front tube plates were practically as good as they were the day that they were put in. The corrugations being cylindrical in shape they are better protected than the firebox tube plate with its weight of tubes which are liable to close it in the center due to so much scale and mud which gathers in the leg of the boiler at that point, and also by the admission of cool air causing a very rapid expansion and contraction. In brief the invention has very successfully met the requirements of the service and bids fair to come into popular use as soon as business conditions warrant a fair trial of what may be looked upon as a radical departure from established practice.

Cooling Passenger Cars on the Great Indian Peninsula Railway

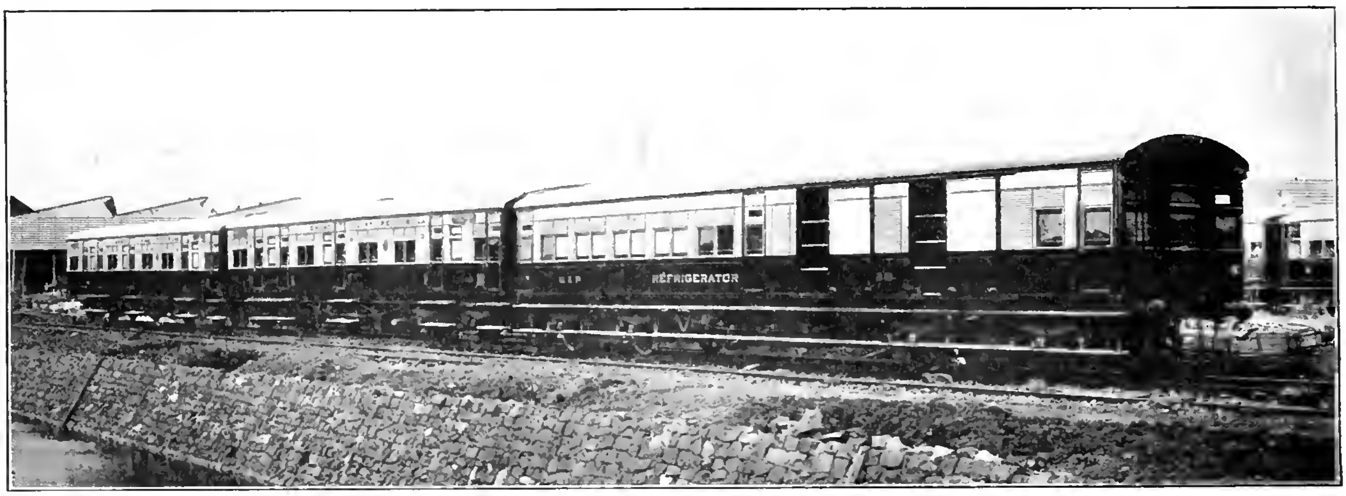
Any readers who have traveled in India, especially during the hot season, April-July, will appreciate the efforts that some of the railways there are making to cool their passenger cars.

For some time past the Great Indian Peninsula Railway, one of the foremost trunk lines of the country, in providing up-to-date rolling stock has fitted in the compartments of its upper class cars an electrically operated cooling device wherein a current of air is drawn by an electric fan through a "curtain" or blind of loosely woven "Khus Khus" moistened with water, thereby producing rapid evaporation and consequent cooling of the air current. "Khus Khus," it should be explained, is the root of a grass which grows in Central India, and which emits a very pleasant and refreshing odor when wet.

Recently the railway mentioned has gone a step further and put on experimentally in one of their Punjab Mail trains, between Bombay and Lahore, a refrigerator car which carries a small but complete cold producing plant operated by electricity, the current being generated by a high speed oil engine carried on board. The plant occupies about one third of the car, the remaining two thirds being utilized as a cold storage chamber. This latter is intended for the conveyance of "perishables" from Bombay to Imperial Delhi and the large cities of the Punjab. On the homeward journey the storage is available for fruits, etc., being brought from the orchards of the North-West to Bombay and the South. The passenger cars running next to the refrigerator have "brine" pipe connections with the cold storage, and along these ice-cold liquid is circulated through "radiators" conveniently placed in the "State" rooms of the cars. An electric fan placed in front in very similar manner to that described is being used with the "Khus Khus" blind introduces a current of air between the numerous tubes of the radiator and delivers a cold blast into the center of the compartment.

To secure the maximum benefits from the "cooler" the windows are shut with the "venetian" sun-blinds dropped and reliance placed on the electric fan for circulation of air. There are ventilators provided in the floor to facilitate circulation downward, the reverse of that required in any process of heating carriages. These ventilators can be regulated by suitable "hit and miss" diaphragms. The bodies of the cars are protected with non-conducting medium built into the sides and roofs.

During the hot season the Punjab mail train on its journey north from Bombay passes through Central India, where a midday temperature of 120 deg. F. in the shade is common. To render traveling comfortable a reduction of at least 20 deg. F. is necessary, and we understand that the experiments so far demonstrate that it is possible to give passengers quite a "cooling" when passing through this hot belt. If the results are found to be as satisfactory as they are anticipated, the Great Indian Peninsula Railway will probably instal such a plant in their specially limited mail trains which leave Bombay on Fridays for Central and Northern India. This enterprising attempt at rendering passengers traveling in the tropics comfortable is commendable and the railway referred to should benefit by their attempt.



GREAT INDIAN PENINSULA RAILWAY REFRIGERATOR CAR COOLING APPLIANCE.

Railway Mail Cars.

An American consul in the Balkan States reports that the post office department of the government to which he is accredited is preparing to purchase a certain number of railway mail cars for use in the interior of the country, as well as for international service. The consul submits names and addresses of agents in his district who might be in a position to represent American car builders.

A Remarkable Natural Bridge

In Argentine there is a natural bridge that is one of the most wonderful in the world. It spans the Rio Mendoza and is known as the Inca Bridge. But it is the work of Nature, and not, as was popularly supposed, of the Incas. The road on which it occurs was probably a colonial highway made by the Peruvian Incas, who took advantage of the phenomenon by leading their road over this natural viaduct.

Electrical Exposition of New York City.

The eighth annual electrical exposition of New York City was held at the Grand Central Palace, that city, October 7 to 17. The exposition included demonstrations of the uses of electricity in the various government departments; modern devices for utilizing electric energy on the farm, in the home, store and factory; electric vehicles, both business and pleasure cars; storage batteries, and numerous garage appliances.

Running at Full Speed.—Mackenzie was having his first experience of life in African forests. Borrowing a gun he set off one day in search of game. Not long afterwards his companion saw him in the distance running at full speed, a huge lion behind him. "Quick! Quick! Jock!" cried Mac. "Open the door! I'm bringing him home alive!"

S. M. Vauclain on Superheaters.

When Mr. S. M. Vauclain makes remarks about anything relating to locomotives his ideas are certain to be interesting and instructive. Some time ago, a paper on Locomotive Superheaters was read by Mr. C. D. Young, engineer of tests of the Pennsylvania Railroad, at a meeting of the Franklin Institute and it was discussed in a most interesting manner by Mr. Vauclain, who said:

On the Continent almost every locomotive of any importance is now fitted with the Schmidt type of superheater, which is a fire-tube superheater. More than one form of fire-tube superheater is used abroad, but in the main they are either a Schmidt superheater or an infringement of a Schmidt, or a superheater of a kind which may be considered an infringement of the Schmidt superheater. In this country many fire-tube superheaters have been devised, but they have all grown out of the idea advanced by Mr. Schmidt. In regard to the fire-tube superheaters, it is very pleasing to me to know that an inventor, even though he may be a foreigner, has been able to preserve and establish in general use an invention of so much value as we can attribute to the Schmidt superheater. I have, of course, opposed the Schmidt superheater at times in very many places—sometimes successfully and sometimes not successfully—but for commercial reasons only; and when those commercial reasons were removed I was very glad of the opportunity to admit that, for general use in locomotives, I considered the Schmidt superheater superior to our own type of low-pressure superheater or any other type of high superheater which we may have employed. Simplicity of construction and the general accessibility of the device also commend it, and in this particular device and in similar devices I feel that nothing has been left undone to make it not only accessible at all times, but easy of maintenance, and as a general thing it is never found fault with by the locomotive engineer who must use the locomotive, but is always spoken of very highly by him.

Now the advantage of using a superheater on a locomotive is, as Mr. Young states, to get more power out of the particular locomotive. That which gives a locomotive its power is its boiler, and any device which can be added to a locomotive to increase the effectiveness of its boiler increases beyond question the effectiveness of the locomotive. The original hauling power or starting power of a locomotive it is impossible to increase because that depends entirely upon the weight on drivers, but it is possible to increase the hauling power of the locomotive in tons and in speed of miles per hour—or, in other words, in horsepower. If you are developing your tractive power at forty miles, you can still increase the horsepower, for the horsepower depends upon the number of pounds of water you are able to evaporate in the boiler. If by a device such as the steam superheater you can get a certain horsepower with 20 per cent. less water or 30 per cent. less water, it is perfectly natural to suppose you can evaporate the same amount of water in this boiler and by the use of a superheater you can develop a speed of, say, 40 miles per hour and haul 30 per cent. additional tons, and it is for this reason Mr. Young, I believe, makes the statement that the lighter-powered locomotives can have their hauling power increased by the addition of superheaters. But do not allow yourselves to be led astray by the fact that these locomotives can haul more tonnage because they can steam any more effectively, but they can haul more tonnage at the speed in miles per hour, and thus increase the earnings of the railroad company owning them accordingly and add to their own intrinsic value to that company. As locomotives have been increasing in size in the last few years, all of us have been struggling with the question of getting the greatest number of tons of freight over the road in a single unit, or at one train movement, and a train movement costs just the same whether it is large or small. The laws of the various States now prescribe the number of men that the railroad must carry to a train, and the principal number of these men are hauled in the caboose. The locomotive engineer really does the bulk of the work—when we dispose of the fireman—the conductor keeps tabs on his car numbers, and the remainder of the crew have a pleasant journey.

The advance in the weight of locomotives in this period has been phenomenal, and even though we thought that we had reached a fair size of locomotive—or a really large size—these locomotives do not prove quite so effective as their size should have made them. It was apparent to us that the reason for this is that we are not able to work the boilers at what they should do on account of the human equation—the human equation being the fireman. Therefore, the superheater man comes along, and applies superheaters to these particular locomotives, and we find we have a very much greater result in hauling trains at different speeds and in their general efficiency, although the demands of railroads for heavy cars and moving heavy tonnage have led us to go back and modify our compound system to include the superheater system, for the purpose of still further reducing the water rate per horsepower and adding to the hauling power of such a unit as can be conveniently employed. Such locomotives are constructed up to a tractive power capacity of about 100,000 pounds, and the limit is supposed to be reached, because even with automatic power we could not get the full capacity of a boiler; and, although it may not have been apparent to any of you here present that a Mallet locomotive, for size, is a very much smaller type than any other locomotive in service, at the same speed at which these engines were operated and with the use of superheaters they seem to be a very desirable engine. Take the case of the automatic stoker; general opposition was made to the introduction of an automatic stoker, because it was said if a fireman was able to shovel the coal there was no necessity for applying automatic devices for this purpose. The result, however, of the experience with various automatic stokers has boiled the art down to probably one or two devices; one device especially is most effective, and, in my judgment, has solved the question of the compounding of locomotives. We have been able lately to construct, for one of the most progressive railroad presidents in the United States today, a locomotive of 160,000 pounds tractive force, and which, in our judgment, and from its ease of movement and its apparent life before any trial in service, is going to be a very successful unit of power. Now, such a locomotive has been arrived at by the careful and intelligent employment of the first principles of locomotive economy, the uniformity, similarity, and the continuity between the different sections. This locomotive is in three sections, with three pairs of cylinders, three sets of driving wheels, one tubular boiler, and an ordinary locomotive engineer and fireman. The compounding of the steam is in the ratio of two to one, which ratio is suitable for superheated steam. The superheater used is a Schmidt superheater similar to the one shown to you tonight by Mr. Young, and is capable of reducing the water rate from 24 pounds to 16 pounds under proper conditions. And, in addition to that, this locomotive has been equipped with a mechanical stoker for supplying coal to the fire and properly distributing it over the surface of the fire; it works admirably, and is successful in every way for firing this locomotive, which will require about 11,000 pounds of coal per hour. No effort whatever on the part of the fireman, with the exception of properly attending to the valves running the engine which drives the firing mechanism, is necessary.

Therefore, you see that, at the present time enjoying the advantages of these economical mechanical inventions of the past one hundred years, the future generation, commencing now in the year 1914, is going to really build large units of power for railroad transportation, and in a few years from now we will look back upon these insignificant pigmies with which we have been transporting trains throughout this country and smile that we did not tumble to these various inventions many years ago.

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Inevitable and Preventable Heat Losses.

One of the first discoveries usually made by students of steam engineering is the fact that as a means of transforming the latent energy of coal into mechanical work the steam engine is an extremely wasteful machine. Scientists have found that a pound of good coal represents about eleven millions of foot-pounds of energy. Very few steam engines develop one million of foot-pounds of work for each pound of coal used in the furnace, and engines utilizing 10 per cent. of the coal are considered thoroughly first class. This percentage of waste appears enormous, and the novice readily concludes that mismanagement must be responsible for a great portion of the wasted power. But increase of knowledge brings a realizing sense of the tremendous difficulties that obstruct the way of radically increasing the efficiency of the steam engine.

There have been a great many prime motors invented for the purpose of converting the latent energy of carbon into mechanical work, and several of them have been capable of utilizing a greater proportion than the steam engine of the heat energy employed, but none have been so reliable for every-day work, and, with all its shortcomings and defects, the steam engine continues to be popular with all power users who find it important that their machinery be kept running day by day without interruption. In popular addresses we are continually hearing the prediction reiterated that science will yet lead the way in effecting radical improvements upon the steam engine. The past achievements of science in this direction have been exceedingly slender, and do not make the promises for future deeds very encouraging. The practical men, on the other hand, whose labors have done most towards developing and perfecting the steam engine, and whose opinions regarding future progress are entitled to the highest consideration, believe that its limit of possible economy has been nearly reached.

Although a steam engine that converts 10 per cent. of the potential energy of fuel into mechanical work may be regarded as a wasteful machine, it is not wasteful when compared with the great mass of engines running our railroad trains and our mills, for very few of these utilize more than 5 per cent. of the heat stored in the coal used. The opportunity for railroad engine improvers at the present day appears to be in carrying out methods which will bring up the performance of the common five per cent. engine towards the high-class engine that takes ten per cent. dividend out of the coal. The men who busy themselves with this problem may safely leave to others the work of improving what is now regarded as the high-class engine. The great avenue of waste with all steam engines is the exhaust steam, and there is no probability that the loss of heat passing out by this channel will ever be radically decreased while steam is employed as a mode of motion. There are, however, lines of economy that may be worked on to advantage by our master mechanics and locomotive designers. Numerous minor causes of waste could be closed up by intelligent management, and the resulting saving would materially increase the economy of the engine. Even the most defective locomotive boilers in use are more efficient in giving back equivalents for the heat received than the best proportioned and best protected cylinders, yet it is easier effecting improvement on the boiler than on the cylinders. A good locomotive boiler accounts for over 50 per cent. of the heat liberated from the coal; few cylinders convert 10 per cent. of the heat of the steam entering them into mechanical work. Still, with all its relative efficiency, there is much preventable waste going on in boilers owing to faults of construction and careless or unskillful management. There is loss from bad proportion of grate surface and flue area, from the gases of combustion being improperly mixed, from defective means of admitting and restraining air supply, from the gases being passed over the heating surfaces too rapidly, from water being passed through the dry pipe along with the steam, and from radiation of heat due to defective covering. The preventable losses in the cylinders are due to too limited expansion caused in various ways, to back pressure caused by faults of design and restricted exhaust opening, to attenuated steam line at short cut-off, and excessive compression resulting also from faulty design of the valve motion, and to condensation caused by imperfect covering, and the interaction of steam in the cylinders known as cylinder condensation and reevaporation.

The prevention of cylinder condensation by using superheated steam is the most important movement in promoting steam engine economy and is making wonderfully fast progress at the present time. By the use of steam superheaters locomotive engines are today using a smaller volume of steam per horse power than first class automatic engines were using ten years ago.

Beauty in Machine Design.

Of late years there have been great improvements effected in the designing of railway machinery, but in many quarters there is still a possibility of making forms of a shape that would be more pleasing to the eye without in the least detracting from utility. These thoughts occurred to the writer while studying a work on the Development of Railways, which gives examples of wonderfully homely forms that look as if the originator imagined that the more ugly an engine or machine could be made the more useful and durable was it likely to be. Apart from the illustrations in the book referred to we have noticed that some persons associate ugliness and utility to be twins.

It is not necessary that we should have the intellectual apprehension of the fitness of anything for its use, in order that we shall feel the sense of harmony and regard the object as beautiful. But if in any case we do have this perception of fitness, then this perception must be satisfied or else the object cannot appear beautiful.

In the earlier days of machine construction, before this construction became a service through the study of its underlying principles, it was the custom to employ architectural forms, these being the forms with which designers of machines

were already acquainted, and very beautiful these adaptations of classic and Gothic features were thought to be. As, however, the unfitness of these forms to resist and transmit mechanical stress, and to perform the various functions which are demanded came to be perceived, and the necessity for entirely new forms designed to meet a new class of requirements, and for freedom in such new designs, untrammeled by the attempt to retain old forms in any degree, came to be realized, how rapidly and how utterly did all the once fancied beauty of these forms in such construction disappear.

We believe that the tendency of pioneer machine tool designers to lend beauty to their forms by imitating architectural patterns arose from the fact that they believed that beauty of form would help their product to favor in the race of competition. The designers of other kinds of machinery had no architectural field to draw upon and they were left to the commendation of utility without regard to appearance.

The pioneer designers of railroad rolling stock were mostly intelligent mechanics who had risen through native ability. Their controlling principle in business was utility without any consideration for anything else. The forms of locomotives and cars resulted from a pure process of evolution, added size and strength being considered safe and proper means of progress. This simple process went on unchecked until William Mason in 1852 appeared as a locomotive builder. Up to that time the ideas of art harmony as applied to locomotive designing had no place in the minds of men engaged in that line of work. They labored with some success to produce locomotives that did the work of hauling trains with fair economy, and they worked out propositions that provided the required strength without carrying a burden of unnecessary material, but no attention seems to have been bestowed upon the outward appearance of the engines, so far as making the visible outlines harmonious was concerned.

There was a great deal of ornamentation put upon some of the parts, but the effect on æsthetic taste was often grotesque when beauty was aimed at. Elaboration of brass in boiler bands and covering of domes, sand boxes, wheel covers, steam chests and cylinders covered with all the vagaries that paint and guilding could produce conveyed the impression one receives from the appearance of an over-dressed woman or vermillion-daubed squaw.

William Mason ended these vagaries of fashion by building locomotives on harmonious lines that did not offend the artistic eye by wrong form or ostentatious ornamentation and the effect of his fine taste is seen in locomotive construction of the present day and not only locomotive construction but in the simplicity of locomotive and machine ornamentation.

Order to Work Harder.

The American workers of all classes are the most diligent people to be found in any country, but yet there is never ending agitation in action, working out schemes to increase the production of our overworked elements of industrial operations. The controlling policy of nearly all industrial establishments in other parts of the world is that workers shall produce a fair day's work for a fair reward of pay, but in this country the policy of so-called scientific management demands that the worker keep his movements going like a high-speed machine.

In European machine shops where workmen are tacitly on their honor to act fairly towards their employers the production is as good as could fairly be expected and harmony prevails between employer and employee; but where a system of artificial forcing is resorted to, as the scientific management humbug promotes, then the worker in self defense proceeds to scheme against the employer. In the industrial history of modern times no movement has exerted such a pernicious influence between employer and employee as the agitation in favor of scientific management. Disguise it as we may the interests of employer and employee are antagonistic and it is not wise to fan the flame of opposition into active hostility. We hardly think that employers are so hard on the poor workers as they were in Robert Burns' day, still they are by no means benevolent. The lines of Burns describing a melancholy condition read:

"Be to the poor like any whinstane
An' haud their noses to the grindstane."

Still in spite of that sad picture the same poet gave cheer by singing, "A man's a man for a' that."

How to Tell If a Crown Sheet Has Been Hot.

Low water, however caused, always produces excessive heating, and if the temperature rises sufficiently to weaken the material, failure may occur by stripping of the stay bolts or rupture of the sheets by bulging between them, or otherwise. If the temperature has raised the material to a low or bright-red color, this can be readily determined by superficial inspection. While the fire side will show red rust or a black color, the water or steam side will invariably show a typical steel-blue scale, which will not disappear even after years, as it is a so-called rustless coating. If this be once oiled it will always be distinguishable, even if the plates had been exposed to moisture and gases for years. The color of this scale will depend somewhat upon the temperature at which it was produced, being brightest at those points where temperature was the highest. Carefully made tests, with autographic diagrams of such material will again demonstrate changes of properties which are very characteristic.

The yield point will be found very low, while the diagram will show a material drop of curve just after the yield point. The elongation will, however, as a rule, be materially increased, with a diminution of tenacity. Nicked and quenched bending tests will again show marked difference between strips cut from the sheet at points which in one case were overheated or were above the low-water line, and in others were taken from a part below this line. The fracture will also be materially different. To demonstrate the temperature at which the plates happened to be at the instant of explosion, it is necessary to cut strips from points of the overheated plate below the water level. These strips polished on the edges are then held in a clear fire so that one end remains cold while the other is heated to a dull yellow or a very bright red. This temperature being reached, the bars are withdrawn, and while one is rapidly plunged with one end into a pot of boiling water, the other is allowed to cool in air, but not in contact with wet metal or stone. When the piece which had been immersed in boiling water about one inch deep has become nearly cold, below blue heat, it is plunged into cold water.

On the polished edges of both bars will be found scale and heat colors, the temperatures producing them being well established. These bars are then carefully nicked at points opposite every change of color and then broken off at these nicks. By comparing these fractures and their scale and color with those obtained from pieces cut from the overheated plates, the temperature at which they were at the instant of explosion can be determined with great accuracy. Having thus determined the temperature at which the sheets were during operation, it is also known whether the metal was sufficiently soft to bulge off or strip from the stay bolts; examination of plates and bolts will verify the conclusion.

Patent Pretensions.

Those who make the most noise about the exclusive use of their right to particular inventions and improvements upon which patents have been granted, often have the most unsubstantial claims to rest upon. Not infrequently a great noise is started and kept up by those perfectly conscious of the weakness of their boasted rights in order to scare away competitors in the same kind of business without testing the strength of the claim. Sometimes it is downright ignorance of the real value of patented claims that gives the greatest assurance and leads to foolish aggression. A new manufacturer of a particular kind of machine or mechanical object, on which patents have been granted, coming into competition with old and

well-established manufacturers of a like article, needs to have a good supply of pluck, energy and penetration, or he may be driven from the field by threats or suits for infringement without having trespassed upon anybody's actual rights or valid patent claims.

Threats of prosecution often accomplish more than the prosecution itself, for purchasers are generally deterred from investing in anything they may be called upon to pay a royalty for using, so long as they can procure something of the same kind without any prospects of a been done by taking advantage of this fact. There is too much inclination demand for royalty. Injustice has been done among business men to accept as established facts many things, simply because they have been so often and so positively asserted without anybody taking pains to deny them. Occasionally some one pulls away this mask, and men wonder why they have been so foolish as to accept a sham for a reality so long without investigating it. Patent rights furnish the material for numerous humbug pretensions.

Increasing Size of Locomotives.

The modern locomotive represents the steady progress of evolution extending over a century. William Hedley's Puffing Billy, the first locomotive to perform car hauling regularly, now preserved in South Kensington Museum, London, is exactly one hundred years old, having been put to work toward the end of 1813. From that crude beginning, the locomotive has slowly developed in size and increased in efficiency, until it is now as efficient a steam user as any engine in service, and it is practically as large as can be carried on 4 ft. 8½ in. gauge of track.

When the primitive locomotives of the decade extending from 1830 to 1840 were built, their designers were experimenting to find the fittest form of railroad motive power. When John B. Jervis in 1830 placed a four-wheel truck in the front of a locomotive and a pair of driving wheels behind, he gave to the railroad world the type that in a direct line produced the variety of forms that constitute the motive power of today.

The first locomotive to do practical work on a railroad in the United States was Peter Cooper's "Tom Thumb," which demonstrated that the crooked track of the Baltimore & Ohio Railroad could be operated by steam engines. That small engine developed about 1½ horse power, and the chief objection raised to its use was lack of power. That objection has been repeated year after year by the officials responsible for moving traffic at low cost, and the men in charge of the motive power have gone on increasing the weight and power of the engines, till now they have passed the two hundred ton mark with 115,000 pounds of drawbar pull.

There have been periods of railroad history when increasing the weight and power of the locomotive went on very slowly; at other times the demand for more powerful engines has progressed more rapidly than the strength of the track that endures the shocks of rapid traction. Never has this demand been so urgent as during the years of the 20th century. It is a long time since leading railroad motive power designers insisted that the modern locomotive had reached the safe weight to be carried upon an 4 ft. 8½ ins. track, but still the increase goes on, year after year, and there is no indication when the increase of weight will stop.

Joseph T. Ryerson & Son Scholarships.

For several years Joseph T. Ryerson & Son, of Chicago, have granted to The American Railway Master Mechanics' Association $500 a year to be employed as a scholarship for a student selected by the association from sons of the members.

A circular has been issued by Secretary Taylor, of the Master Mechanics' Association, intimating that a special committee of the association was appointed at last convention to review the condition of the Joseph T. Ryerson & Son scholarships, and that this committee has been authorized to announce that the donors have increased the annual amount to cover two scholarships of $300 each, to take the place of the $500 annual donation.

The scholarships shall provide for four years' course at Purdue University, the University of Illinois, the University of Wisconsin, or such other university as the American Railway Master Mechanics' Association shall from time to time elect.

To be eligible for candidacy for these scholarships, applicants must have at least twelve months' practical experience in the mechanical department of an American railroad. The Joseph T. Ryerson & Son scholarship will not be awarded to any person who has already completed a year's work in any technical school or university.

Each applicant must file with the secretary of the American Railway Master Mechanics' Association the following credentials:

(a) A statement over his own signature that he is an applicant for one of the Joseph T. Ryerson & Son scholarships.

(b) The certificate of a member of the American Railway Master Mechanics' Association covering his practical experience.

(c) The certificate of a reputable physician that he is in the possession of good health and a strong body.

(d) The name of the university or technical school which he desires to enter.

Upon receipt of these documents the secretary of the American Railway Master Mechanics' Association will return a blank application and school certificate, to be filled out by the candidate and by him returned to the secretary.

The examination which shall determine the successful candidates shall be conducted by the College Entrance Examination Board, which conducts regularly annual examinations in all of the principal cities.

Credit for practical experience shall be allowed as follows:

For more than 18 months, but not more than 24 months, 10 points; for more than 24 months, but not more than 36 months, 15 points; for more than 36 months, 20 points.

Information regarding rules, regulations and requirements will be furnished to candidates upon application to Mr. J. W. Taylor, secretary, American Railway Master Mechanics' Association, Karpen Building, Chicago.

Growth of People's Government.

This government is passing from a hierarchy of politicians to a government of the people. And the change is coming not so much because the politicians have grown more corrupt than they have been, but because the moral sense and the moral enthusiasm of the people have awakened. The schoolhouses and the press have quickened the wits of the people so that they have grown shrewd. But it is a lamentable commentary upon organized religion in this country that the moral awakening of the nation apparently has been unaided by the churches. Lawyers, doctors, reporters, farmers, merchants, laborers and brokers have become public leaders in the new cause. But although the cause is essentially moral, appealing to quickening consciences, no preacher has become a national leader in it, as, for instance, Beecher was a leader of the Abolition movement. And while many preachers have sanctioned the movement, have given it a blessing perhaps, the only clerical leaders who really have distinguished themselves in connection with the awakening morals of the people are those who have denounced the movement as sensational, as vicious, and as altogether deplorable. Instead of checking the current, these preachers have only attracted attention to their own cupidity. And so in spite of the lack of encouragement from any church as a church, the people have moved on impelled by the school and the press and are making their fight for righteousness and for the establishment between men of that justice which must come before there may be an honorable "peace on earth."

Classification Yard Lighting of the Pittsburgh & Lake Erie Railroad at Pittsburgh, Pa.

It is a very generally known fact that the average railroad derives its revenue principally from freight traffic, often carrying passengers at a loss. Therefore, anything that tends to facilitate the movement of cars or handling of freight is looked on with favor by the railroads.

Of the very greatest importance in freight handling but little known to the general public because of its infrequent contact therewith, is the classification yard. The function of this yard is the collection of freight cars into trains for specific destinations or routes. After the train has been made up with its proper quota of cars, it proceeds to the receiving yard where it waits until opportunity is afforded for it to pass out over the scales and be weighed, and proceed thence on its route.

The car or group of cars entering the yards travels by gravity under the care of a rider who directs it to its proper place in the yard and from whence he returns a foot to the head of the yard where additional cars are obtained and distributed.

As these yards are in operation 24 hours a day, it may easily be realized how important it is to have them properly lighted.

An interesting discussion of the lighting of railroad yards is given in a paper recently presented by Messrs. H. Kirschberg and A. C. Cotton on "Railroad Illuminating Engineering Track, Scale and Yard Lighting," before the Pittsburgh Section of the Illuminating Engineering Society.

The authors state that the freight haulage capacity of a road is as dependent on the scale and yard capacity as it is on motive power equipment, and that a congestion in the yards will reduce the earning power just as effectively as the disablement of a locomotive or other rolling stock.

The lighting of an area such as is presented by this class of yard affords some unique problems, the successful solution of which greatly facilitates the movement of freight traffic. The yard is not to be considered as an open area but, in reality, as a series of streets three or four feet wide, with buildings (freight cars) about fourteen feet high, on both sides.

One of the most effective installations of lighting in a classification yard recently made is that of the Pittsburgh and Lake Erie Railroad at McKees Rocks, just outside the city limits of Pittsburgh, Pa. This yard contains about twenty tracks extending for approximately one-half mile.

The source of light is the Cooper Hewitt Quartz lamp, mounted on steel towers, as shown in the accompanying illustrations. The installation consists of eight units, the lamps being rated at 2,400 candle-power, with an energy consumption of 720 watts, resulting in an efficiency of .3 watts per candle. Direct current at 220 volts is supplied to the lamps from the power plant of the company located nearby.

The towers, which are twelve feet square at the base, are 100 feet high and are spaced about 400 feet, in two rows one on each side of the yard, or approximately 225 feet across. The lamp is suspended from a short mast arm which extends out over a platform for the attendant, access to which is had by means of a ladder mounted on the side of the tower

A chain and a cut-out, however, permit the lamp to be lowered from the ground, thus obviating the necessity of the lamp attendant climbing the tower.

As the quartz burners have a life of several thousand hours, and the globes are at such a height as to be out of the smoke zone, almost no cleaning or other attention is required.

The ideal condition of illumination of the yard, is, of course, to make it as light by night as by day, so that the riders, when directing the cars to their proper spaces in the yard, may be able to see clearly the location of other cars and thus prevent them from excessive "bumping."

The illumination of the McKees Rocks yards, which has been installed under the

LIGHTING APPLIANCES AT THE PITTSBURGH & LAKE ERIE RAILROAD YARDS AT PITTSBURGH, PA.

direction of Mr. D. P. Morrison, electrical engineer of the Pittsburgh and Lake Erie Railroad, very nearly approaches this ideal condition.

The light given by the lamps spaced as they are, completely floods the yards, enabling the man to see with proper clearness, not only every track and car but also the switches at the head of the yard. The illumination is such that one may readily read a newspaper at night. The entire absence of shadows and glare greatly facilitates the movement of the cars throughout the yard, by permitting the exact location of each to be easily determined, and also greatly adds to the safety of the men and tends to prevent accidents.

Possibly the best commendation given the efficiency of the installation is the statement made by one of the railroad officials "the yard men never lose any chance to praise it." Considering the well known reluctance of the average individual to praise his working conditions, this statement is peculiarly significant.

In addition to the increased speed in handling cars gained through the better lighting, conditions are made much easier for the men returning afoot to the head of the yard, as when the yard is poorly lighted, it is difficult for them to avoid incoming cars, switches, posts and other obstacles, and the Pittsburgh & Lake Erie employees are particularly pleased with this feature.

The fact that the lamps are mounted at such a height permits an excellent distribution of the light, which possesses an inherent color value that is particularly suitable for outdoor illumination.

Another feature that peculiarly adapts the Quartz lamp to this field of lighting is the steadiness of the light, other forms of illuminants having repeatedly proved unsatisfactory because of the unsteady light emitted, which was not conducive to good work.

The installation has not been in service long enough for any operating data to be secured, but in view of the high efficiency of the Quartz lamp and the minimum attendance required, it is confidently expected that the costs of operation will be equally as satisfactory as the other features of the installation.

Development of Signals.

At a recent meeting of the New York Railway Club Mr. H. S. Balliet said:

You know that the signal business had its start with the use of hand signals and flags, followed by lanterns, and a little later switch lights. The development has been from a one-half to a two inch flat wick to a fount or cup carrying anywhere from one pint to two quarts of oil. The lenses have varied all the way from four to twelve inches. The earliest development, from purely a signal standpoint, has been traced back to the use of a wooden box in which was placed a kerosene light, and in front of the light ordinary plain window glass, either uncolored or colored to suit the indication to be given. This was used for handling trains on what is today the Belvidere Division of the Pennsylvania Railroad. This was merely the forerunner of what is now known as an optical lens, or its equivalent, or perhaps more correctly, the roundels which are now placed in signal spectacles.

Dr. Churchill tells us the story that a negro down south invented the long-time burner because he was too lazy to get around every day to fill the lamps. I am quite surprised at the Doctor's knowledge of history. I always believed that he had been in the service long enough to know the true history of the long-time burner. As a matter of fact it originated on the Lehigh Valley Railroad, where a lampman covered a large mileage including automatic signals, train order signals, station lights and switch lights. It was a hard matter for one man to take care of this number of lights and he found it very difficult to get around to fill and clean them each day. He sought to contrive to get this job so that he could give satisfaction at all times by having satisfactory indications displayed. This lampman worked on the section where the famous section foreman removed the "Ireland" signal after he had been ordered by the road master to take it down. You may not be clear as to what an "Ireland" signal is. It is a large wooden box provided with a ventilator at the top in which is mounted a kerosene light. The front or approach side in which trains run, is provided with a large plain glass. Between the lamp and this glass is operated a curtain or flag of the ordinary marine type. A red flag is used, and when it is desired to display a stop indication, the flag is drawn up in front of the light. The section foreman was apparently not clear as to the name of this particular signal. The use of this signal had been done away with because of the substitution of electric "banjo" signals, track circuit controlled, and it was the desire to remove the mechanically operated signal, hence the order. Instead of removing the "Ireland" signal, he actually dug out the masts and removed the distant or green signals for the new system. Asked as to why he did this, he stated, "Begorra, isn't green Ireland's color?"

The long-time burner was invented by a man named Dodson, hailing from Scranton, Pa. He was not only trying to get along enough service to warrant the removal of the ordinary one-day lamps, but he was also trying to beat the Standard Oil Company out of selling large quantities of oil, and he has succeeded. The first cup used was supplied with one pint of oil, and even though it was a crude burner and wick affair, gave a satisfactory signal between four and five day and night continuous burnings.

There have, of course, been many improvements on the efficiency of the long-time burner, and today it is far superior to any flat wick arrangement known.

Gold Beating.

Gold beating is accomplished by means of a wooden hammer weighing from seven to eighteen pounds on a sheepskin cushion resting on a granite block. The gold beaten is usually 22 or 23 carats fine. A little alloy of copper or silver is added to make it spread. It would be impossible for the beaters to handle perfectly pure gold.

Gold leaf is packed more by the aid of the breath than that of the hands. The operation of transferring a sheet of almost transparent gold leaf from one place to another is of such delicacy that it is possible to accomplish it only by a slight puff of the breath. The packers are for the most part girls, to whom, after beating, the gold leaf is handed.

The girls lift the unshaped leaf from the mold with a pair of wooden pincers, flatten it out on a sheepskin cushion by gently blowing on it, cut it into a perfect square, replace it between the leaves of the book and flatten it out with the breath. A "book" consists of twenty-five leaves, and a skilled girl operator can pack seventy books in a day.

There is great diversity in the degree of skill acquired by the different gold beaters. Some of the girls earn twice the wages others draw, and with no great effort.

Boilermakers After a Quiet Life.

New York City is not considered a quiet town, not a place which persons would choose for a season of quiet repose. The noise of the place is admitted by everybody who has had to sleep in the city, but we think that the Boilermakers' Convention rubbed it in a little when after holding a convention in New York they passed a resolution stating that they were glad to return to the quiet life of their shops again.

No Doctor.

"I haven't any doctor at all!" remarked the boy Tommy with calm dignity. "Then do you ever take any medicine?" was the next question. "Oh, don't I?" Willie replied. "Father's a dentist, mother's a homeopath, my eldest sister's joined the ambulance class, grandma goes mad over every new medicine, and uncle's a vet. Yes," he added, with a faraway look in his eyes, "and they all practice on me."

Air Brake Department

Calculating Train Stops.

Judging from the nature of inquiries recently received from some of our readers relative to the distances in which passenger trains can be brought to a stop from different rates of speed, and under a variety of conditions with the emergency brake, we must have inadvertently created the impression that if given the weight of cars, locomotives, nominal percentage of braking power employed, per cent of grade, radius of curves in track and speed in miles per hour, the actual distance in which a train of cars can be stopped by an application of the air brake could be calculated to within a few feet with any nondescript apparatus. It is our desire to attempt to correct this inference and briefly mention the factors that must be considered in calculating the distance in which a train can be stopped by the brake, and to print a number of formulas used by air brake engineers in estimating or calculating stopping distances. Such calculations differ, somewhat from ordinary engineering problems where tensile strength of materials and formation of construction are considered and a certain per cent. added as a factor of safety, as in all requests the exact point of stop is demanded with no allowance in either direction.

As an illustration of the variation in the factors that enter into a train stop, during a certain series of tests the train was being stopped by the brake under the prevalent conditions in practically uniform distances, and the following morning the same stops were attempted, but the distances were found to be about 200 feet longer, and in ascertaining the cause it was found that new shoes had been applied to the engine and tender during the night, which, as soon as they were worn smooth, resulted in stops of approximately the same distances as previously made, and it was also discovered that the conditions of the brake shoes alone can vary the distance of a stop as much as twenty per cent. However, a mean or average of these factors has been obtained from elaborate demonstrations, and their accurate establishment will become apparent from a study of the formulas.

Many years ago, mechanical calculations were largely governed by an experimental system because of an absence of scientifically conducted investigations, but the basis for present day mechanical calculations is the law of conservation and transformation of energy, so that in bringing the calculation of the distance in which a train of cars can be stopped by an air brake, we find first the foot pounds of kinetic energy stored in the train. This found it follows that the work done by the brake from the time of effectiveness to the point of stop must equal the foot pounds of energy stored in the train, or in other words, the work done in stopping a train is the retarding force multiplied by the distance through which it acts, that is, the length of stop.

As a basis for determining foot pounds energy, Newton's Law of Universal Gravitation teaches that the acceleration of gravity is approximately 32.2 feet per second—that is, a body falling for 1 second will fall 16.1 feet, and at the end of the second will be traveling at the rate of 32.2 feet per second. It may be well to note that while the speed of the body at the end of the second of time is 32.2 feet per second, the average rate of speed is 16.1 feet per second.

To find the number of foot pounds energy stored in a moving train, the weight is divided by 32.2, the acceleration of gravity, which gives what is termed the mass, and one-half the mass multiplied by the square of the speed equals the foot pounds of kinetic energy possessed by the body in motion or where M = mass, and V = velocity, $\frac{1}{2}MV^2$ = foot pounds energy. As an example, if we wish to find the foot pounds energy of a car weighing 100,000 lbs. moving at the rate of 60 miles per hour, 50,000 lbs. $\div$ by 32.2 = 1552. At 60 miles per hour the car will be moving 88 feet per second, $88 \times 88 = 7744$. $7744 \times 1552 =$ 12,000,000 foot pounds energy.

As to the retarding force available for destroying or dissipating this vast amount of energy, the Westinghouse Air Brake Company is now able to furnish a brake for a car of this weight that will show what is termed an overall efficiency of 10 per cent. of the weight of the car. This includes the average co-efficient of brake shoe friction obtained during the stop, and the average per cent. of brake rigging efficiency on such weights of cars. Assuming then a braking power of 125 per cent., and an overall foundation brake gear efficiency of 10 per cent., the rate of retardation will be $32.2 \times .10 \times 1.25 = 4.02$ feet per second. As an indication of how these relationships are applied, 100 per cent. retarding force would equal 32.2 feet per second, that is, the speed would be reduced at this rate. This retardation is not instantly secured as it is 2 seconds before full brake cylinder pressure can be attained with the pneumatic brake which, however, does not refer to the electro-pneumatic brake, but the effect is approximately the same as though one-half the retardation was secured from the time the brake was first applied until it is fully on.

That is, the speed will be reduced by $4.02 \div 2 \times 2 = 4.02$. When the brake is fully applied the speed will be $88 - 4 = 84$, and the distance covered while the brake is being applied is $88 + 84 \div 2 \times 2 = 172$. To reduce the speed to 0 from a speed of 84 feet per second, with a retardation of 4 feet per second, per second, requires 21 seconds' time. The average speed during this time is $84 \div 2 = 42$, or the distance covered is $42 \times 21 = 882$ feet.

The length of the stop is therefore $882 + 172 = 1054$ feet.

From the foregoing it is obvious that to find the distance in which a train stop can be made, the retarding force must be known, and it is found by multiplying the car weight by the percentage of braking power employed to find the nominal shoe pressure, and as all the nominal brake shoe pressure cannot be realized as retarding force because of losses through the foundation brake gear and frictional limitations of brake shoes, the overall efficiency of the brake must be found, and when it is, the per cent. of overall efficiency multiplied by the nominal shoe pressure will be the retarding force of the brake. This per cent. of overall efficiency is derived from averages of extensive series of tests, and during recently conducted tests, especially designed apparatus was used for determining the per cent. of brake rigging efficiency.

In a paper read before the January meeting of the Central Railway Club, Mr. W. V. Turner elaborated upon brake calculations as one phase of his subject, and the foregoing is based upon his elucidation of the manner in which they are made. According to this interpretation if P represents the braking power, W the weight of the train, el the overall efficiency of the brake and F the retarding force, then F = WPel.

Illustrating how the relationships are actually applied, if we wish to find the retarding force and then the braking power necessary to stop a car weighing 100,000 lbs. from a speed of 60 miles per hour in 1,000 feet, and assume that 2 seconds' time is required to apply the brake in full, that is, the mean time 1 second. Then before the retarding force commences to act the car will have traveled a distance of 88 feet, and the re-

tarding force really acts through a distance of 1000 — 88 = 912 feet. The kinetic energy which has been found to equal 12,000,000 foot pounds divided by 912 equals 13,200 lbs. retarding force required.

If the overall efficiency of the brake is taken at 10 per cent., the necessary braking power will be 13,200 ÷ (100,000 + .10), which will be 132 per cent. of the weight. It must, however, be understood that to produce an actual 132 per cent. braking power may mean that the nominal percentage of braking power is from 150 per cent. to 180 per cent. Conversely, if the average retarding force throughout the stop is given as 10 per cent. of the car weight, and it is asked what the stopping distance will be from a 60 mile per hour speed, the retarding force will be 100,000 lbs. × .10 = 10,000 lbs., and the stopping distance will then be 12,000,000 ÷ 10,000 = 1,200 feet.

Concluding the references to brake calculations, Mr. Turner stated: "Some may say that this is theory, or mathematics, and not practice, or will not work out in practice, but I controvert this by saying I have shown that this is not so. Moreover, it is the analysis of a stop, subdivided into its elements, and thus discovering where the variables that caused such variations in stops exist, that has led in many cases already, and will in many more in a short time, to improvements in these respects, with the result that the variable elements have been made more constant than heretofore, thus making it quite possible to install a brake whose actual performance agrees closely with what was expected from the calculated design."

In accord with the requests from our readers for formulas used by the manufacturers in designing brake equipments, we submit these formulas which will be self explanatory to those who have advanced far enough in the study of the air brake to become interested in the fundamental principles of brake operation and brake design:

1

Formulae Used in Brake Calculations.

$$E = FS \quad (1)$$

$$E = \tfrac{1}{2}MV^2 \quad (2)$$

$$F = WPef \quad (3)$$

$$S = \frac{V^2}{2gPef} \quad (4)$$

$$A = WG \quad (5)$$

$$P_1 = \frac{G}{ef} \quad (6)$$

$$S_1 = \frac{V^2}{2gef(P - P_1)} \quad (7)$$

$$p = g(G - Pef) \quad (8)$$

E = Kinetic energy, ft. lbs.
F = Retarding force, lbs.
S = Length stop, ft.
M = Mass train.
V = Velocity train, ft. per sec.
W = Weight train, lbs.
P = Braking power, per cent.
e = Brake rigging efficiency, per cent.
f = Co-efficient friction.
g = Acceleration of gravity.
A = Accelerating force due to Grade G, lbs.
G = Per cent. grade.
P_1 = Braking power necessary to prevent acceleration on Grade G.
S_1 = Length stop on Grade G, ft.
p = Acceleration due to Grade G, ft. per sec. per sec.

L-6

2.

E = FS
E = Kinetic energy, ft. lbs.
F = Retarding force, lbs.
S = Length stop, ft.

This formula is based on the fundamental assumption that the work done in stopping a train equals the kinetic energy stored in the train at the commencement of the stop.

From data obtained in an actual stop,
E = 183,100,000 ft. lbs.
F = 142,062 lbs.
S = 1310 ft.

FS = 142,062 × 1310 = 186,100,000 = E.

$$\frac{186{,}100{,}000 - 183{,}100{,}000}{186{,}100{,}000} = 1.6\%$$

This is as close as can be expected from service results.

L-8

3.

$E = \tfrac{1}{2}MV^2$
E = Kinetic energy, ft. lbs.
M = Mass = weight divided by acceleration of gravity $= \frac{W}{g}$
V = Velocity, ft. per sec.

Example:

Find the kinetic energy stored in a train consisting of 1 locomotive weighing 388 tons, and 6 passenger cars weighing 137,000 lbs. each, at a speed of 58.41 m. p. h.

Weight train in lbs. = 388 × 2,000 + 6 × 137,000 = 1,598,000 lbs.
Mass train = 1,598,000 ÷ 32.2 = 49,627.
The velocity V must be in ft. per sec.
To change m. p. h. to ft. per sec. multiply by 147 (5280 ÷ 3600 = 1.47) 58.41 × 1.47 = 85.9 ft. per sec.
$E = \tfrac{1}{2} \times 49{,}627 \times (85.9^2) = 183{,}098{,}817$ ft. lbs.
E = 183,098,817 ft. lbs.

L-9

4.

F = WPef
F = Retarding force acting on train, lbs.
W = Weight train, lbs.
P = Braking power train, per cent.
e = Brake rigging efficiency, per cent.
f = Co-efficient friction.

Example:

Find the retarding force acting on a train consisting of 1 locomotive weighing 388 tons, and 6 passenger cars weighing 137,000 lbs. each, when the braking power of the entire train is 104.6%.

Weight train in lbs. = W = 388 × 2000 + 6 × 137,000 = 1,598,000 lbs.
Braking power, per cent. = P = 1.046.
Brake rigging efficiency = e = .85. Average value from tests.
Co-efficient friction = f = .10. Average value from tests.
Retarding force = F = 1,598,000 × 1.046 × .85 × .10 = 142,062 lbs.
F = 142,062 lbs.

L-10

5.

$$S = \frac{V^2}{2gPef}$$

S = Length stop, ft.
V = Initial velocity train, ft. per sec.
g = Acceleration of gravity = 32.2 ft. per sec. per sec.
P = Braking power entire train, per cent.
e = Brake rigging efficiency, per cent.
f = Co-efficient friction.

Example:

Find the distance in which a train can be stopped from a speed of 58.41 m. p. h. with a braking power of 104.6%.

V must be in ft. per sec.
To change m. p. h. to ft. per sec. multiply by 1.47 $\left(\frac{5280}{3600} = 1.47\right)$
V = 58.41 × 1.47 = 85.9 ft. per sec.
P = Braking power = 1.046.
e = Brake rigging efficiency = .85. Average value from tests.
f = Coefficient friction = .10. Average value from tests.

$$S = \frac{(85.9^2)}{2 \times 32.2 \times 1.046 \times .85 \times .10} = 1288 \text{ ft.}$$

S = 1288 ft.

L-11

6.

A = WG
A = Accelerating force due to Grade G, lbs.
W = Weight, lbs.
G = Per cent. grade

Example:

Find the accelerating force acting on a car whose total weight is 140,000 lbs. when the car is on a grade of 1.5%.
W = 140,000
G = .015
A = WG = 140,000 × .015 = 2100 lbs.
A = 2100 lbs.

L-12

7.

$$P_1 = \frac{G}{ef}$$

P_1 = Braking power necessary to prevent acceleration on Grade G.
G = Per cent. grade.
e = Brake rigging efficiency, per cent.

f = Coefficient friction.

Example:

Find the braking power necessary to prevent a car whose total weight is 150,000 lbs. from accelerating on a grade of 1.5%.

G = .015

e = .85. Average value from tests.

f = .15. Average value from tests.

$$P_1 = \frac{G}{ef} = \frac{.015}{.85 \times .15} = .117$$

$$P_1 = 11.7\%$$

L-13

8.

$$S_1 = \frac{V^2}{2gef(P - R)}$$

S_1 = Length of stop on Grade G, ft.

V = Initial velocity train ft. per sec.

g = Acceleration of gravity = 32.2 ft. per sec. per sec.

e = Brake rigging efficiency, per cent.

f = Coefficient friction.

P = Braking power train, per cent.

P_1 = Braking power necessary to prevent acceleration on Grade $G = \frac{G}{ef}$

Example:

Find the distance in which a train can be stopped from a speed of 30 m. p. h. on a grade of 1.5% if the braking power of the entire train is 20%.

V must be in ft. per sec.

To change m. p. h. to ft. per sec. multiply by 1.47 $\left(\frac{5280}{3600} = 1.47\right)$

V = 30 × 1.47 = 34.1 ft. per sec.

g = 32.2

e = .85. Average value from tests.

f = .15 Average value from tests.

P = .20

$$P_1 = \frac{G}{ef} = \frac{.015}{.85 \times .15} = .118$$

$$S_1 = \frac{(34.1)^2}{2 \times 32.2 \times .85 \times .15 \times (.20 - .118)} = 1728 \text{ ft.}$$

$$S_1 = 1728 \text{ ft.}$$

L-14

9.

$$P = g(G - Pef)$$

P = Acceleration due to Grade G, ft. per sec. per sec.

g = Acceleration of gravity = 32.2 ft. per sec. per sec.

G = Per cent. grade.

P = Braking power, per cent.

e = Efficiency brake rigging, per cent.

f = Coefficient friction.

Example:

Find the acceleration resulting from a train whose braking power is 8% descending a 1.5% grade.

G = .015

P = .08

e = .85. Average value from tests.

f = .15. Average value from tests.

$$P = 32.2(.015 - (.08 \times .85 \times .15)) = .155 \text{ ft. per sec. per sec.}$$

P = .155 ft. per sec. per sec.

L-15

Feed Valve Repairs.

As an essential to successful air brake operation on modern passenger and freight trains, an accurate brake pipe feed valve is undoubtedly of more vital consequence than any other unit of the air brake system. Regardless of the fact that brake operation without a feed valve is possible, as in descending grades with the brake valve in full release position, but this does not represent the ordinary conditions of service, also control valve and universal valve equipments are designed to prevent slight variations in brake pipe pressure from applying the brakes, hence the demands are less exacting, but where triple valve equipments are considered, and they will be in use for a number of years to come, it is absolutely necessary that the feed valve be maintained more sensitive to open and close than the most perfect triple valve is to apply and release, otherwise undesired applications of brakes will result and there will be an experience with the train of evils that follows in the wake of sticking brakes.

It is not desired to give a detailed account as to how a feed valve should be repaired, as the various operations have been touched upon from time to time, and for the present we would confine any comment to repair work in general as carried on in the average railroad repair shop. When the majority of repaired feed valves are placed on a rack for test, they are inclined to manifest a variety of symptoms of disorder, as, for instance, they may suddenly and without any apparent cause change their figure of adjustment or start a variety of indications of overcharge or slowness to cut off or may entirely fail in the separations of pressure and under 70 lbs. pressure may operate satisfactorily and show the correct fluctuation and still vary widely when the pressure is increased to 110 lbs., for all of which there are good and sufficient reasons.

Given a feed valve with regulating valve bushing in from fair to good condition, a practically perfect supply valve piston bushing and a piston large enough to permit of an accurate fit, the average repairman will be enabled to do the necessary fitting, eliminate undue friction and turn out an accurate and reliable feed valve, but if these bushings are materially impaired by wear or are of an inferior composition of metal the results desired by air brake men will not be attained.

The writer has had considerable experience with bushing feed valve bodies and somewhat more from observing the results of applying supply valve piston bushings in railroad repair shops and has used various methods of enlarging or "squeezing" the piston to fit slightly worn bushings and as a result has for a number of years been under the impression that this work cannot be done economically or in a satisfactory manner in the average railroad shop first, because there is a question as to whether the quality of the material necessary for the work can be purchased, and secondly, the price would be too high if it could be obtained, and again there is no machinery in railroad shops with which to true up the inside of the bushing after it has been applied.

The squeezing of a piston seldom, if ever, uniformly increases its size, and the points enlarged are usually at the extreme ends, and with the bushing worn a trifle and the piston applied, the interstice of piston and bush is too irregular, thus the piston fit is too neat at certain points, and permits of too much leakage at others.

As to the metal required for bushing, no purchasing agent who has studied scientific management would consider paying, say 25 or 30 cents per pound for brass if some outside firm offers a substitute combination of cast borings and coke dust at say 15 cents per pound, and any one who has carefully observed the cost of economy in the purchase of inferior materials will agree that in purchasing air brake supplies there is no such thing as economy in a cheaper first cost. Air Brake Association papers have for several years pointed out the cost of a cheaper air hose and air hose gasket, and we know of several instances in which the saving on first cost of air hose gaskets would not pay for 25 per cent. of the stationary used in investigating the causes of undesired brake applications and hose uncoupling, to say nothing of stuck brake, flat wheels, relocation of air pipes and cost of maintaining air compressors.

The economical purchase of air brake supplies is a large field of work that the air brake man has been unable to break into, and the outcome is some very amusing attempts to obtain 100 per cent. efficiency with various consignments of junk, but it will not always be thus.

The most economical method of feed valve repairs the writer has ever been able to institute has been to return feed valves with worn supply piston and regulating valve bushings to the Westinghouse Air Brake Company for repairs, and if there is any question as to results it will only be necessary to ascertain cost of repairs and make a test of shop repaired valves with those returned by the Air Brake Company.

Competition of Locomotives.

Shortly after the Liverpool & Manchester Railway was under construction the directors of the company sent out an invitation to locomotive inventors to enter into competition to demonstrate the engine best fitted for hauling railway trains. That led to what was known as the Rainhill contest in which Robert Stephenson's Rocket took first place.

The success of that competition moved the directors of the Baltimore & Ohio Railroad to inaugurate a similar competition and under date of January 1, 1837, the following invitation was issued:

The Baltimore & Ohio Railroad Company being desirous of obtaining a supply of locomotive steam engines of American manufacture, adapted to their road, the president and directors hereby give public notice, that they will pay the sum of four thousand dollars for the most approved engine which shall be delivered for trial upon the road on or before the first of June, 1831—and that they will also pay three thousand five hundred dollars for the engine which shall be adjudged the next best and be delivered as aforesaid, subject to the following conditions, to wit:

1. The engine must burn coke or coal, and must consume its own smoke.

2. The engine, when in operation, must not exceed three and one-half tons weight, and must, on a level road, be capable of drawing day by day, fifteen tons exclusive of the weight of the wagons, fifteen miles per hour. The company to furnish wagons of Winans construction, the friction of which will not exceed five pounds to the ton.

3. In deciding on the relative advantages of the several engines, the company will take into consideration their respective weights, power and durability, and, all the other things being equal, will adjudge a preference to the engine weighing the least.

4. The flanges are to run on the inside of the rails. The form of the cone and flanges, and the tread of the wheels must be such as are now in use on the road. If the working parts are so connected as to work with the adjustion of all the four wheels, than all the wheels shall be of equal diameter not to exceed three feet, but if the connection be such as to work with the adhesion of two wheels only, then those two wheels may have a diameter not exceeding four feet and the other two wheels shall be two and a half feet in diamter, and shall work with Winnas' fiction wheels, which last will be furnished upon application to the company. The flanges to be four feet seven and a half inches apart from outside to outside. The wheels to be coupled four feet from center to center in order to suit curves of short radius.

5. Pressure of the steam not to exceed one hundred pounds to the square inch, and as a less pressure will be preferred, the company in deciding on the advantages of the several engines will take into consideration their relative degrees of pressure. The company will be at liberty to put the boiler, fire tube, cylinder, etc., to the test of a pressure of water not exceeding three times the pressure of the steam intended to be worked, without being answerable for any damage the machine may receive in consequence of such test.

6. There must be two safety valves, one of which must be completely out of the reach or control of the engineman, and neither of which must be fastened down while the engine is working.

7. The engine and boiler must be supported on springs and rest on four wheels, and the height from the ground to the top of the chimney must not exceed twelve feet.

8. There must be a mercurial gauge affixed to the machine with an index rod, shewing the steam pressure above fifty pounds per square inch, and constructed to blow out at one hundred and twenty pounds.

9. The engines which may appear to offer the greatest advantages will be subjected to the performance of thirty days regular work on the road; at the end of which time, if they shall have proved durable and continue to be capable of performing agreeably to their first exhibition, as aforesaid, they will be received and paid for as here stipulated.

P. E. Thomas, President.

N. B.—The railroad company will provide and will furnish a tender and supply of water and fuel for trial.

Persons desirous of examining the road or of obtaining more minute information, are invited to address themselves to the president of the company.

The least radius of curvature of the road is 400 feet.

Competitors who arrive with their engines before the first of June, will be allowed to make experiments on the road previous to that day.

The editors of the *National Gazette*, Philadelphia; *Commercial Advertisers*, New York; and Pittsburgh *Statesmen*, will copy the above once a week for four weeks and forward their bills to the B. & O. Railroad.

The competition did not take place in the ordinary form, but five engines differing radically in form were offered to the company. They were, first, the Johnson, built by George W. Johnson, of Baltimore. It had two vertical cylinders and a horizontal boiler with twin pistons. The second was the "York," built by Davis & Gartner, a four-wheel engine with vertical boiler and cylinders. This was the favorite among the locomotives offered and became for a time the pattern for other engines built for the Baltimore & Ohio Railroad.

The third engine was the "Cortell," built by a watchmaker named Stacey Cortell. It had a Galloway boiler and oscillating cylinders. It never did work worth mentioning. Next came the "Childs," the product of another watchmaker named Ezekiel Childs. That engine was a decided novelty, for it had rotary cylinders and a vertical tubular boiler. The fifth engine was the "James," designed and built by William T. James, a locomotive that might have made its mark, but for the bursting of the boiler early in its career. The engine had a pair of vertical cylinders and a peculiar vertical boiler. The greatest novelty about it was a link motion, the first applied to any engine.

None of the engines proved entirely satisfactory, but their design and construction indicated that American mechanics were capable of producing the motive power needed for operating the railroads that were in their infancy.

The Tie That Bound.

Archaeologists have discovered the palace of Jezebel, who, it will be remembered, was an ancient dame of uncertain temper, mostly bad. In the palace the grubbers found more than five thousand cooking utensils, which might go to show that despite her violent outbreaks the ancient dame was a good cook and a provident housekeeper.

And this suggests a Lincoln story.

When the great emancipator was practicing law in Indianapolis a client came to him and wanted to know if something couldn't be done to protect him from his wife. He said she locked him out nights, threw dishes at him and battered him up with a club. She scolded him day and night, and consistently and continuously made life miserable for him.

"Have you thought of getting a divorce?" inquired Lincoln.

"No, no, I don't want a divorce. Why, I wouldn't leave th' old woman for anything."

"You wouldn't! After all that abuse? And why not?"

"Because, squire, that old woman of mine can make the best flapjacks in Sangamon county!"

Tedious Train Ride.

It was a long-suffering traveller on a little single-track railroad, and he complained bitterly about the lateness of the train and the irregularity of the service. The employee remonstrated in virtuous indignation. "I've been on this here line, sir," he began, "upwards of eight years and——" "Have you, indeed?" interrupted the traveller, sympathetically. "At what station did you get on?"

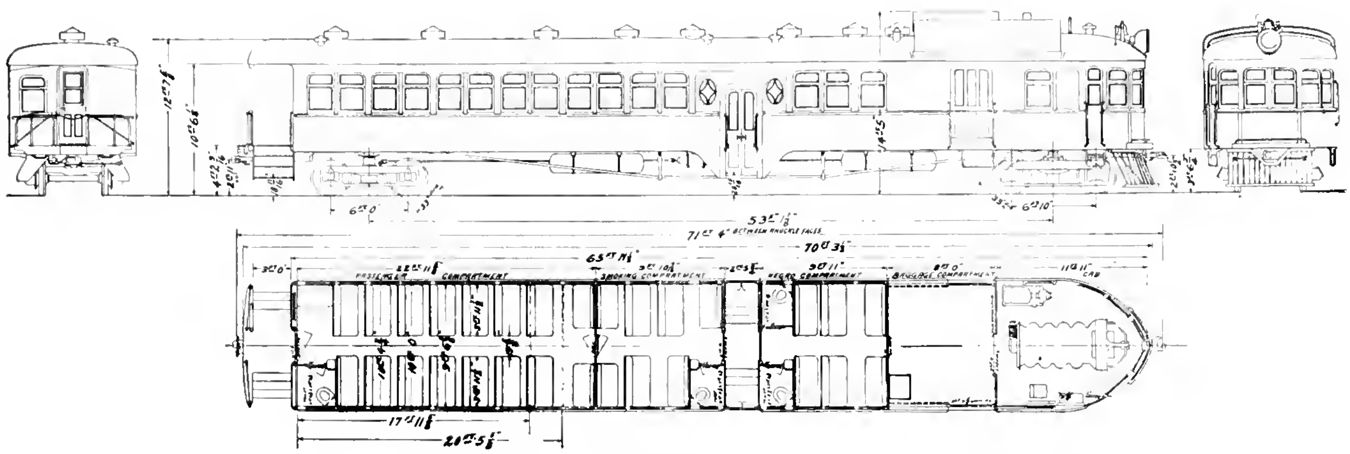
Gas-Electric Motor Cars for the Illinois Central Railroad and the Spokane, Portland & Seattle Railway

The Illinois Central Railroad Company, Chicago, Ill., has recently contracted with the General Electric Company for four gas-electric motor cars, which will be placed in commission for supplementary service on some of the connecting lines of the company. The railway company has not yet advised where all these cars will be placed in operation, but is canvassing the branch line service on its entire system to ascertain where they may be used to the best advantage. The initial installation will probably be distributed partly on southern and partly on northern branches of the road.

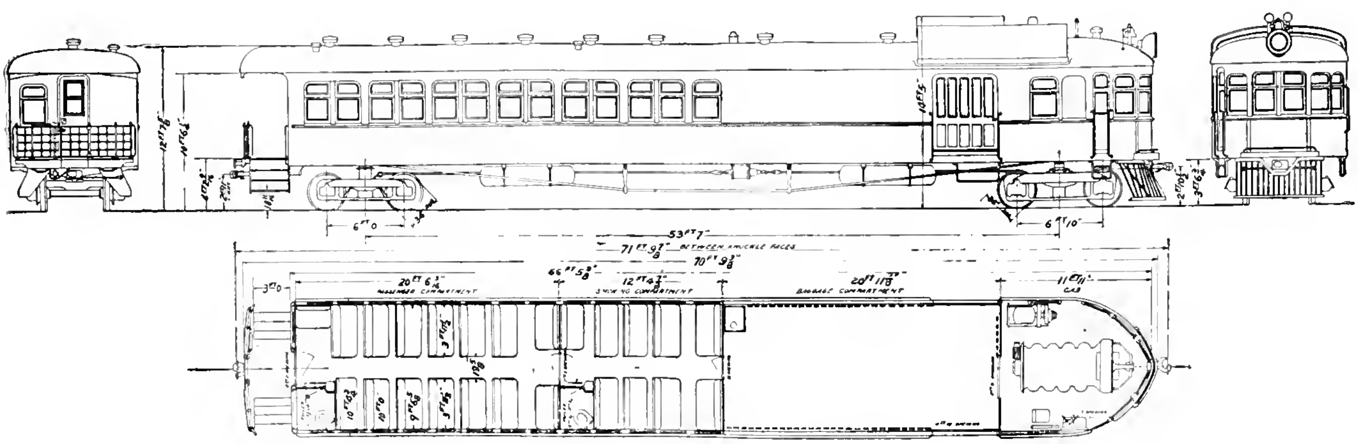
The cars for this company will be what is known as type CRE-70-B-8. The details of construction conform in general to those of the standard gas-electric motor cars manufactured by the General Electric Company. These cars measure 71 ft. 3⅞ in. over bumpers by 10 ft. 6⅜ in. wide over all, weigh approximately 51.5 tons, seat 86 passengers and are each equipped with two GE-205, 600 volt, box frame, oil-lubricated, commutating pole railway motors having a total of 200-hp. capacity. The motors are mounted with nose suspension directly on the axles of the forward truck. The generating unit consists of an 8-cylinder, 4-cycle gas engine of the "V" type, direct-connected to a 600 volt, commutating pole electric generator, designed to meet the special conditions the service demands.

The interior of the cars is partitioned into five compartments. The cab in front containing the power plant apparatus measures 11 ft. 11 in. long; next is the baggage room, 8 ft. long; then the colored passenger compartment, 9 ft. 10⅞ in. long; the smoking section, 9 ft. 10 in. long; and the passenger compartment, 22 ft. 11⅞ in. long. The track is the standard 4 ft. 8½ in. gauge.

The body of the cars is of all-steel construction, except the seats and interior finish, which is of mahogany. Center vestibules with side entrances run between the passenger and smoking and cooking and colored passenger compartments. A rear platform entrance is also provided. The bearings and treads and flanges of the wheels conform to MCB standards. The trucks are of the heavy swing bolster type, with elliptic bolster and coil equalizer springs.



TYPE OF GAS-ELECTRIC CARS FOR THE ILLINOIS CENTRAL RAILROAD.



TYPE OF GAS-ELECTRIC MOTOR CAR FOR THE SPOKANE, PORTLAND & SEATTLE RAILWAY.

The Spokane, Portland & Seattle Railway has contracted with the General Electric Company for a gas-electric motor car, which will be the first car of this type to be employed on this railway. It is the intention to place the car in operation between Portland and Rainier, Ore., on the Astoria-Columbia division of the road.

Steam trains are now making two round trips each way per day between these two cities, 45.8 miles apart; leaving Rainier 7:40 a. m., arriving at Portland 9:45 a. m., and leaving Portland 12:50 p. m., arriving at Rainier at 2:40 p. m.; leaving Rainier 3 p. m., arriving at Portland 5 p. m., and leaving Portland 5:35 p. m., arriving at Rainier 7:25 p. m.

The total distance for the four single

trips per day is 183.2 miles. The gas-electric motor car will be required to haul regularly one 25-ton trailer seating 60 passengers. At times when traffic is heavy, it may be necessary to haul two trailers of this capacity on both round trips. The schedules of trains composed of the motor car and two trailers will be increased 10 minutes each run with stops of not more than 30 seconds. The maximum grade on this section of the railway is one-half of one per cent., extending over a distance of about 3 miles; but, in general, the road follows the Columbia River grade and is nearly level.

The Spokane, Portland & Seattle Railway runs from Spokane, Wash., through Portland, Ore., to Warrenton, Port Stevens and Holladay on the coast. It connects with Seattle, Wash., over the Great Northern Railway and the Northern Pacific Railway. Other connecting lines are the Oregon Trunk Railway, Oregon Electric Railway and the United Railways. The road embraces a total of 556 miles, standard 4 ft. 8½ in. track gauge. The rolling stock equipment comprises 69 locomotives, 98 passenger cars and 740 freight and miscellaneous cars.

The gas-electric motor car for this railway is what is known as type RE-70-B-21. The details of construction conform in general to those of the standard cars manufactured by the General Electric Company. It will be noticed, however, that the baggage room in the car is about twice the usual length, in order to transport the large quantity of express handled, particularly the heavy shipments during the fruit season.

The specific dimensions of the car are 70 ft. 11⅜ in. over bumpers by 10 ft. 6⅜ in. wide over all. It weighs approximately 51 tons and has a seating capacity for 68 passengers. The interior is partitioned into four compartments. The cab in front containing the power plant apparatus measures 11 ft. 11 in. long; next is the baggage room, 20 ft. 10⅞ in. long; then the smoking section, 12 ft. 6 in. long, and the passenger compartment, 20 ft. 5⅞ in. long.

The car is equipped with two GE-205, 600-1,200 volt, box frame, oil-lubricated, series, commutating pole railway motors having a total of 200 hp. capacity. The motors are mounted with nose suspension directly on the axles of the forward truck. They are insulated for 1,200 volts, so that they may be interchanged, if desired, with the motor equipments on the cars of the Oregon Electric Railway, which operates on the 1,200-volt system. The generating unit consists of an 8-cylinder, 4-cycle gas engine of the "V" type, direct-connected to a 600-volt, commutating pole electric generator, designed to meet the special conditions the service demands.

The body of the car is of the all-steel type of construction, except the seats and interior finish, which is of mahogany. A rear open platform entrance with body and platform railings is provided. The bearings and treads and flanges of the wheels conform to MCB standards. The trucks are of the heavy spring bolster type with elliptic bolster and coil equalizer springs.

Lights and Shadows of Mexico.

When railways were first built in Mexico many ambitious graduates of United States railroads looked upon railroad life in Mexico as something very much to be desired, and many of them accepted offers to help in operating the lines south of the Rio Grande. Many of the aspirants for experience in a foreign country returned disappointed, but enough of them adhered to their jobs to give the railroads a fair start on United States methods.

William Joseph Showalter, writing to the National Geographic Society of Washington, says among other interesting things:

"No other country south of the Rio Grande is so well supplied with railroads. Prior to the Madero revolution it had 20,000 miles of up-to-date American railroad, which carried 11,000,000 passengers annually and handled about 11,000,000 tons of freight. Their total revenues amounted to about $40,000,000. The government owns a controlling interest in the major portion of the mileage of the railroads.

"You may tread the burning sands of a tropical desert with the wet of the perpetual snow of towering mountains still upon your shoes. You may take a single railway journey of thirty-six hours in which the people you see at the railroad station will be dressed in four different weights of clothing. Everywhere you turn there is contrast, high lights and deep shadows.

"Mexico probably has a greater range of remarkable vegetation than any other country in the world. The parrot fruit tree produces an odd-shaped fruit, bearing a close resemblance to green parakeets. When the parakeet is frightened it makes a dash for the parrot tree, where it assumes a position which makes it look like the fruit itself. So close is the resemblance that their enemies, the hawks, occasionally fly by a tree on which a dozen or more of these birds are sitting, apparently unaware of their presence. Another remarkable tree is the 'Arbol de Dinamite'—dynamite tree—whose fruit, if kept in a warm place, bursts with considerable force and a loud report, scattering its flat seeds to a surprising distance.

"Mexico produces one-third of the world's silver, a considerable percentage of its gold, one-ninth of its lead, and one-twentieth of its copper. The country's mineral production, exclusive of iron, coal and petroleum, amounted to $158,000,000 in 1910.

"The famous iron mountain at Durango is estimated to contain 600,000,000 tons of iron ore, which is worth seven times the value of all the gold and silver mined in Mexico in two centuries. The Santa Maria graphite mines are the largest and most important in the western world. The region around the Gulf of Mexico is very rich in petroleum. One company at Poteri del Llano struck a gusher which flowed 100,000 barrels of oil a day.

"The drawn work of the Mexican Indian is justly famed throughout the world and deserves to rank with the finest of Spanish and Italian laces. The Indians make all sorts of small objects to attract the centavos of the tourist. The little dolls of Cuernavaca, a half inch tall, and dressed in finely embroidered raiment, are the admiration of every one who sees them. The small clay animals, perfectly fashioned, and ranging from the peaceful dog to the charging bull and the bucking mule, would do credit to the genius of many a sculptor whose name figures in the art publications of the world.

"With a university established before John Harvard, Elihu Yale, or William and Mary were born, the masses of its people are hopelessly ignorant. With a hospital founded before Jamestown was even dreamed of, it is one of the most backward regions of the earth in a medical way. With natural riches greater than those of a thousand Midases, its masses are just as poor as the proverbial church mouse. With a constitution as perfect as any organic law in the civilized world, it is a nation whose rulers always have been a law unto themselves.

"Here you will see a Mexican half-breed barefooted wearing a dollar pair of trousers, a fifty-cent shirt and a ten-dollar sombrero. There, at a single glance and within the length of a single city block, you may see an Indian cargador, a donkey, an ox cart, a carriage, a railroad train, a street car, and an automobile—almost every type of locomotion since Adam."

Confidence.

Remember this fact, that if you consider yourself a worm of the dust you must expect people to trample on you. If you make a doormat of yourself people are sure to wipe their feet on you. More men fail through ignorance of their strength than through knowledge of their weakness. You may succeed when others do not believe in you, but never when you do not believe in yourself. The curiosity of him who wishes to see fully for himself how the dark side of life looks is like that of the man who took a torch into a powder mill to see whether it would really blow up or not.

Double-Headed Flexible Stay-Bolts

The universal favor with which the flexible stay-bolt has been received by all engaged in locomotive boiler construction has been so marked that a still further improvement in stay-bolts cannot fail to attract wide attention. Mr. J. R. Flannery already distinguished by his inventions, has secured a patent on an improved stay bolt for boilers which, as shown in the accompanying illustrations, is a combination of a pair of oppositely disposed sleeves each open at its ends, and each provided with an integral curved seat, a stay-bolt having two spherical heads, one of which is detachably secured to the bolt, the heads resting against the curved seats in the sleeves, and caps for the sleeves, the inner faces of the caps being curved to conform to the contour of the head.

As shown in Fig. 1, the sleeve projects outwardly beyond the outer sheet of the boiler to carry the bearing in the usual manner, while the sleeve in which the opposite end of the bolt is mounted is so located with relation to the inner sheet that the bearing for the inner head is in a plane between the two sheets. This sleeve is threaded externally, and is screwed into an opening in the inner sheet, with its outer end flush with the face of the sheet. It is provided internally with a curved bearing for the head of the bolt, and internally threaded at its outer end for the reception of the cap, which when in place rests against the annular shoulder of the sleeve with its outer surface flush with the outer face of the inner sheet. This head is smaller than the outer head, and is provided with a threaded socket into which the threaded end of the bolt is screwed. To apply the bolt to its connectors or sleeves, the caps of the sleeves and the head of the bolt are removed, and the bolt is passed through the larger sleeve into the smaller or inner sleeve, after which the head is scr wed on to the bolt and the caps screwed into place.

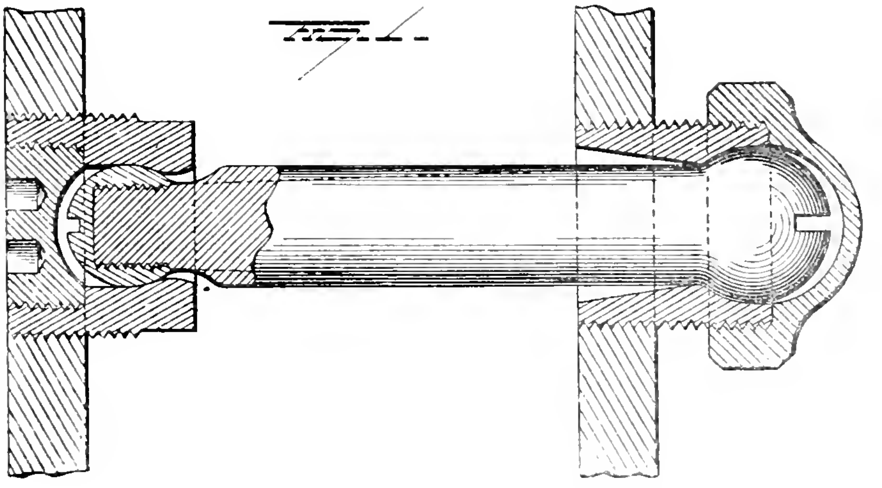


Fig. 1.

In the variation of construction shown in Fig. 2, the bolt is shortened, and is mounted at its two ends in sleeves similar to the inner sleeve of Fig. 1, so that both heads of the bolt are supported on planes between the two sheets. In Fig. 2, the removal head is approximately the same size as the integral head. It will be readily seen therefore that the principal feature of this bolt is that it has spherical heads at both ends, the heads being mounted in spherical bearings in the sleeves so as to compensate for the contraction and expansion which takes place in both sheets. As is well known where the ball and socket principle of connection is applied to one sheet only, the opposite end of the bolt being threaded into the inner sheet, there is always a slight movement in the threaded connection between the inner end of the bolt and the inner sheet and the continuation of this movement eventually causes leakage and also a crystallization of the metal in the bolt.

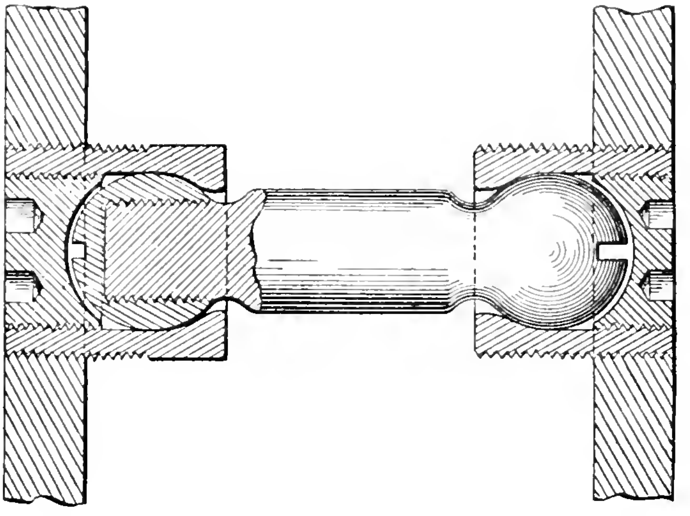


Fig. 2.

It is evident that as the modern locomotives are gradually enlarging their fire boxes, there will be consequently greater expansion and contraction because of the greater surfaces exposed to the fire and cold air. By making both ends of the stay-bolts flexible this objection will be overcome, and by making both heads spherical, without projections of any kind, and the seats in the sleevs and cap of a radius to conform to the curve of the heads, any sediment that gathers around the heads will simply reduce the size of the cavities without interfering with the universal movement of the heads.

It has also been observed that in the event of stay-bolt leakage certain areas in fire boxes have exhibited a greater tendency than others to fracture bolts and it is safe to assert that if stay-bolts of this particular new form were applied to these portions of the fire boxes a greater degree of safety would be accomplished. It will be interesting to observe the result of the application of the new device and while some time must elapse before comparative data can be furnished the enterprising company under whose supervision the device is being applied may be relied upon to furnish reports at as early a date as possible.

Changing Colors.

The Nashville, Chattanooga & St. Louis on September 8 changed the colors of its signal lights on the Paducah and Memphis division, adopting green for the proceed indication and yellow for caution. At the same time long-time burners were put into the lamps. Hand signals used to indicate caution will be made yellow lanterns, flags and fuses.

Largest Wireless Station.

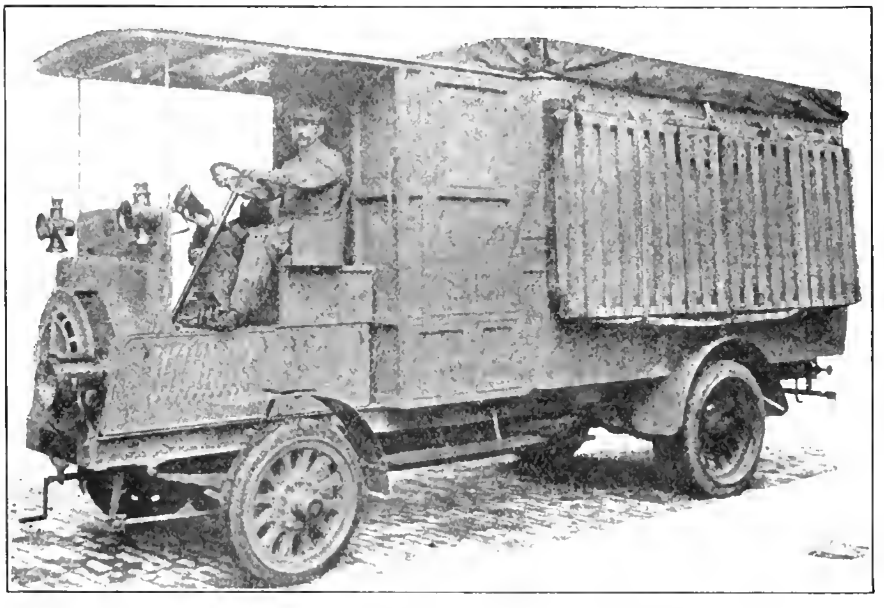
The largest wireless transmitting station in the world is the Cefndu station, near Carnarvon, Wales, which is to be used for direct communication with New York. The elevation is about 1,400 feet above sea level, and there are ten steel masts, each 400 feet high.

Electrical Department

Automobile for Sterilizing Water.

A new automobile, developed in France just before the war broke out, will be of great service now where sterilized water is needed in large quantities and it was designed mainly with a view of using it on the battlefield. The automobile carries a whole sterilizing plant so that it is ready for work at a moment's notice. The scheme is to take water on one side, and after passing through the filters and sterilizers, the water is delivered at the other side of the car into a canvas tank. This tank is shown folded against the side of the car in the illustration.

To the automobile engine is connected a dynamo, mounted on the inside of the car. An ozone generator, receiving current from the dynamo produces the ozone in the regular manner, by means of a high tension discharge. A current of air, charged with the ozone is sent into the mixing tank holding the water, and by the use of a special device the air is mixed with the water so that the ozone kills all the microbes. Before the water receives the ozone treatment it is thoroughly filtered.



PORTABLE OUTFIT FOR STERILIZING WATER BY MEANS OF OZONE.

The Wireless Direction Finder.

It is wonderful what rapid strides have been made during the last few years with wireless telegraphy until now it takes its place foremost among many inventions. Wireless is still in its infancy and new attachments and applications for its use come up continually. One of the latest is the Direction Finder, which will enable the ship receiving a message to know just the exact point of the compass from which the message was sent.

Aerial wires, distinct from those used for the main wireless are required. Two loops of wires of equal size are suspended vertically and cross each other at right angles. Usually the loops are in the form of triangles with the base longitudinal and crossing the deck at an angle of 45 degrees. The instruments are connected to the base of the triangles and placed as near as possible so as to keep the length of these wire connections as short as possible.

The instrument indicates the angle which the direction of the land station makes with the center line of the ship, but it does not indicate in which direction. For instance, the message may be coming from a station 20 degrees off the port bow but without further observations it would not be known whether it was coming from this point or diametrically opposite.

If there is any ambiguity, two successive bearings taken of the same station, while keeping the ship on a fixed course, will place the matter beyond doubt, and will at the same time give the ship's distance from the station by the method ordinarily in use for that purpose. In the same way the ship's position may be found by taking simultaneous bearings of two fixed stations.

An obvious application of the Direction Finder is to find out whether the ship is on a course which will take it inside or outside a lightship or isolated lighthouse. A few signals from the lightship or lighthouse will settle the question as certainly as if the light were visible. Similarly, when making a harbor, a few signals from a station in the harbor will show immediately if the ship has drifted to one side of the entrance. When trying to locate another vessel while going slow in a fog, the indication of the Direction Fnder would show by a steadily increasing strength of signal if the other ship was approaching, but might leave a doubt as to whether it was approaching on the port bow or overhauling on the starboard quarter. But a wireless query as to her course, addressed to the other ship, would remove the doubt at once.

Rotary Converter vs. Motor Generator Sets.

With the rapid increase of high voltage transmission lines the power consumer is confronted with the question as whether to use a rotary converter or a motor generator set to change over the alternating current to direct current. Each has its advantages, but a study of the characteristics of the two types of machines will enable the person to make the proper choice. Assume that the transmission voltage is 6,600 volts, 60 cycles, and the consumer requires a direct current voltage of 600 volts.

Rotary Converter.—When the machine is located near the transmission line the rotary converter is the most satisfactory. It has a higher efficiency and has a liberal capacity for power-factor correction. It is very necessary on a large alternating current system to keep a high power factor so as to keep the transmission line losses to a minimum and the rotary converter lends a means of improving the power factor. With 600 volts d. c. it is necessary to step down the 6,600 alternating through transformers to about 460 volts. The transformers will protect the rotary against lightning. For the majority of cases the rotary converter offers the most advantage.

Motor-Generator Sets.—The motor-generator sets can be divided into two classes, the *Synchronous* and the *Induction.*

The synchronous motor-generator set is used where most of the load from the transmission line supplies induction motors. For instance, a factory will have induction motors connected to many ma-

chines, using the alternating current, but will require for lighting or other circuits direct current. The induction motor load makes a very low power factor and by using a synchronous motor this power factor is greatly improved. The synchronous motor has a larger power factor correction than the rotary converter.

The induction motor generator set is used when most of the load is direct current or where the power factor correct tion is not important. This machine has the maximum overload capacity of the three types and the motor speed characteristics can be such that a fly-wheel system will give a fairly uniform alternating current load.

The Thury System.

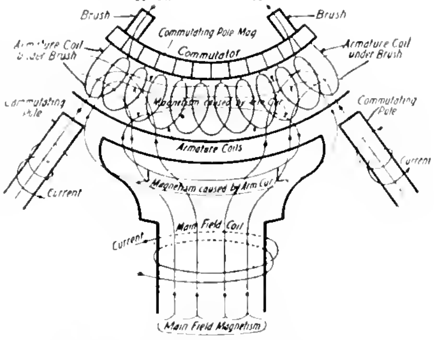
When high voltage transmission is spoken of, one is apt to think of an alternating current system as this system is used so extensively today. However, there is a high voltage direct current system, known as the Thury system, which has transmitted power as high as 60,000 volts. A number of constant current, commutator type, direct current generators are connected in series to give the desired voltage and instead of the current varying with the load and the voltage remaining constant, the current is kept constant and the voltage varied. To make use of the power at the distribution end a series of motors must be used, each connected to a generator. The whole object in giving to this high voltage direct current transmission is to save losses in transmission. There are a good many drawbacks to the system and it is doubtful if it is ever used to any great extent, although there are transmission lines abroad 100 miles in length.

The Interpole or Commutating Pole Railway Motor.

Explain briefly what is the function of the interpole and what relation it bears to the main poles? A.—This is one of several similar questions received recently and we are covering this subject in detail so that it will be entirely clear. To all those who have had experience with the interpole railway motor it is well known that the introduction of the commutating pole has completely eliminated sparking and flashing so common in many of the older types. This is accomplished by the commutating pole changing the distribution of magnetism between the main poles so that as the coils pass under the brush, at which point they are short circuited, they will not be in a magnetic field such that sufficient voltage will be generated between bar to flash over if a slight spark had been started. Each coil undergoes a reversal of current as it passes under the brush and it is necessary that the magnetism or flux in this commutating zone be of small value. By the use of interpoles a flux is formed which opposes this flux in the commutating zone and reduces it to a minimum. As a result the voltage between bars at the brush is very low, too low to cause a spark as the commutator bars leave the brush. Since there are no sparks at the brush to start a flash the commutating-pole motor will not flash over under conditions which would cause the non-commutating motor to do so.

Fig. 1 shows a portion of the motor and gives diagrammatically the current and magnetism in the different parts of a Westinghouse interpole motor. The commutator, brushes, armature winding, commutating poles and main pole are shown and the lines of flux or magnetism are also drawn in.

In the non-commutating motor the current flowing in the armature coils sets up a flux through the core (the iron part of the armature) and around the pole pieces. This flux or magnetism partially passes through the short-circuited coils undergoing commutation and causes all



DIAGRAMMATIC SKETCH OF MAGNETISM AND CURRENT IN A WESTINGHOUSE RAILWAY MOTOR.

the trouble. This armature magnetism depends on the amount of current in the coils so that as the load, increases the more chance of flashing.

The inter or commutating poles are placed opposite the brushes and they are connected in the circuit so that the same current that passes through the coils will pass through the interpoles. These commutating poles send flux through the coils in the opposite direction to that caused by the armature coils, thus killing this latter flux and making a perfect commutating motor.

The elimination of sparking not only reduces the chances of flashing or "bucking" but it prevents the deterioration of the brushes and long mileage is obtained.

Effect of Voltage on Railway Motor Performance.

That the speed of a railway motor is increased or decreased as the voltage at its terminals is raised or lowered is well known, but the exact relation between the speed and voltage under these circumstances is apparently not generally as well known as it should be.

The voltage at the terminals of a railway motor may be divided into two parts. The first of these is required to overcome the internal resistance of the motor and is equal to the product of the resistance in ohms by the current in amperes. This component is constant for a given current regardless of the terminal voltage.

If a certain 50-horsepower motor has a resistance of .5 ohms, the voltage required to force a current through the windings will be 15 for a current of 30 amperes, 50 for a current of 100 amperes, and a proportionate value for any other current

The second component of the terminal voltage is equal to the difference between the total and the first component. It is known as the counter e. m. f. and is a measure of the speed at which the motor is running and of the work which it is doing when it is operating under any given conditions.

The speed of a railway motor when operating with any given current is directly proportional to its counter e. m. f. If the 50-horsepower motor referred to above is operating at 30 amperes and 600 volts, the voltage required to overcome the internal resistance is 15 and the counter e. m. f. is 585. If the voltage at the terminals is reduced to 500 and the current remains the same, the counter e. m. f. is then reduced to 485 volts instead of 585, and the speed of the motor will be reduced in this same proportion.

The ratio of 485 to 585 is 0.829, which means that if the speed at 600 volts had been 1,000 r. p. m., that at 500 volts will be 829. The ratio of 500 volts to 600 volts is 0.833. It is thus evident that the speed is reduced in greater proportion than the voltage.

If the motor had been operating at 100 amperes instead of 30 amperes this effect would have been even more noticeable. The counter e. m. f.'s in this case would have been 450 and 550 respectively, and the ratio would have been 0.818 as compared with the voltage ratio of 0.833

If the voltage had been reduced to 400 instead of 500, the decrease in speed as compared to the decrease in voltage would have been still more marked. In this case the speed ratios would have been 0.685 and 0.636, respectively, at 30 and 100 amperes as compared to the voltage ratio of .667.

The torque or tractive effort which the motor develops is practically independent of the voltage and is determined by the current alone. As long as the motor is drawing a given current the torque will be essentially the same, regardless of the voltage at the terminals.

It will be seen from the above, therefore, that if the resistance of a motor is available and a characteristic curve at any one voltage, the performance at any other voltage can be readily calculated.

Items of Personal Interest

Mr. S. E. Nell has been appointed car foreman of the Chicago, Rock Island & Pacific, at Rock Island, Ill.

Mr. Paul Zitterman has been appointed boiler shop foreman of the Santa Fe, with office at San Bernardino, Cal.

Mr. A. Anderson has been appointed boiler foreman of the Chicago, Rock Island & Pacific, at Manly, Iowa.

Mr. B. Flaherty has been appointed general car foreman of the Chicago, Rock Island & Pacific, with office at Manly, Ia.

Mr. P. F. Harris has been appointed day roundhouse foreman of the Chicago, Rock Island & Pacific, at Manly, Iowa.

Mr. J. M. Kilfoyle has been appointed master mechanic of the St. Louis Southwestern of Texas, with office at Tyler, Tex.

Mr. M. D. Ingram has been appointed terminal foreman on the Missouri & North Arkansas, with office at Helena, Ark.

Mr. Frank L. Fox has been appointed general foreman of the car department on the Pere Marquette, with office at Detroit, Mich.

Mr. William V. Wicks has been appointed road foreman of engines of the Northern Pacific, with office at Jamestown, N. D.

Mr. W. H. Hadley, formerly repair track foreman of the Santa Fe, at Richmond, Cal., has been appointed car foreman at Winslow, Ariz.

Mr. V. W. Robinson has been appointed representative in Michigan for the Independent Pneumatic Tool Company, with office at Detroit, Mich.

Mr. A. Disbrow has been appointed roundhouse foreman of the Santa Fe, with office at Belen, N. M., succeeding Mr. C. Brooks, resigned.

Mr. L. D. Richards has been appointed master mechanic of the Rock Island, with office at Little Rock, Ark., succeeding Mr. W. F. Moran, transferred.

Mr. John A. Rieber, formerly coach yard foreman of the Santa Fe, at Richmond, Cal., has been appointed repair track foreman at that place.

Mr. M. E. Wells has been appointed senior inspector of motive power for the Interstate Commerce Commission, with office at Chattanooga, Tenn.

Mr. O. E. Shaw has been appointed general car foreman of the Chicago & Eastern Illinois, with office at Danville, Ill., succeeding Mr. Harry C. Love, resigned.

Mr. Charles Manley has been appointed master mechanic on the Missouri & Northern Arkansas, with office at Harrison, Ark., succeeding Mr. J. P. Dolan, resigned.

Mr. T. J. Kennedy has been elected president and general manager of the Algoma Central & Hudson Bay, and the Algoma Eastern, with offices at Sault Ste. Marie, Ont.

Mr. William R. McMunn has been appointed general car inspector of the New York Central & Hudson River, with office at Albany, succeeding Mr. F. W. Chaffee, deceased.

Mr. William Schuman has been appointed general foreman of the shops of the Chicago, Indianapolis & Louisville, with office at Lafayette, Ind., in place of Mr. George Crumbo, resigned,

Mr R. A. Billingham, formerly master mechanic of the Apalachicola Northern at Port St. Joe, Fla., has been appointed master mechanic of the Tennessee Central, with office at Nashville, Tenn.

Mr. J. H. Wood has been appointed supervisor of locomotive operation of the Oklahoma and Panhandle divisions of the Rock Island and Gray's Harbor branches, with office at Tacoma, Wash.

Mr T. B. Van Dun, first vice-president of the Van Dun Iron Works Company, Cleveland, Ohio, has been elected president of the company, succeeding his father, Mr. J. H. Van Dun, who died recently.

Mr. William Schmalzried, formerly master mechanic on the Chicago & Alton, has been appointed superintendent of shops of the Oregon Short Line at Pocatello, Idaho, succeeding Mr. D. J. Malone, deceased.

Mr. T. S. Krahenbuld, formerly general foreman on the Southern at Selma, Ala., has resigned, and is succeeded by Mr. Lock Atwell, formerly roundhouse foreman on the same road at Birmingham, Ala.

Mr. Charles M. Schwab, president of the Bethlehem Steel Company, has resigned as a director of the American Locomotive Company, and Mr. Andrew Fletcher has been elected a director to succeed him.

Mr. N. L. Smitham, formerly master mechanic at the Bellmead shops of the Missouri, Kansas & Texas, has been transferred to a similar position on the Texas Central, with office at Walnut Springs, Tex.

Mr. George Searle, formerly roundhouse foreman of the Santa Fe at San Bernardino, Cal., has been appointed master mechanic of the San Pedro, Los Angeles & Salt Lake at Las Vegas, N. M., in place of Mr. W. A. Rogers, resigned.

Mr. C. S. Yeaton, formerly supervisor of locomotive operation of the Chicago, Rock Island & Pacific at El Reno, Okla., has been appointed road foreman of equipment at the same place, succeeding Mr. O. F. Covalt, who has been assigned to other duties.

Mr. C. E. Stanton, formerly road foreman of engines on the Smithville district of the Missouri, Kansas & Texas, has resigned to return to service as a locomotive engineer, and Mr. A. Hallman has been appointed to the position vacated by Mr. Stanton

Mr. J. J. Clark, formerly foreman of machinery on the Missouri, Kansas & Texas at Walnut Springs on the Texas Central, has been transferred to the Bellmead shops of the Missouri, Kansas & Texas as master mechanic, in place of Mr. Smitham.

Mr. George P. Johnson, formerly general manager of the Chesapeake & Ohio, has been elected president and general manager of the Virginia-Carolina, and the New River, Holston & Western, with offices at Abingdon, succeeding Mr. W. E. Minega, resigned.

Mr. C. A. Thanheiser, formerly engineer maintenance of way on the Missouri, Kansas & Texas, has been appointed superintendent of the Smithville district of the Missouri, Kansas & Texas, succeeding Mr. J. F. Hickey, transferred to the Choctaw division as superintendent.

Mr. W. J. Miller, formerly master mechanic of the St. Louis Southwestern of Texas, at Tyler, Tex., has been appointed superintendent of motive power on the St. Louis Southwestern, with offices at Pine Bluff, Ark. Mr. Miller fills the vacancy caused by the death of Mr. T. E. Adams.

The executive committee of the Traveling Engineers' Association at their last meeting unanimously elected Dr. Angus Sinclair to honorary membership in the association. In conveying the honorary certificate Mr. W. O. Thompson, secretary of the association, paid a glowing eulogium to Dr. Sinclair for the active and abiding interest that he had taken in

the formation and work of the association.

Mr. E. H. Chrysler, formerly master mechanic on the Chicago & Alton at Slater, Mo., has resigned to accept position as superintendent of shops on the Oregon Short Line, with office at Pocatello, Ida., and Mr. J. H. Schmidt, formerly general foreman at Roodhouse, has been promoted to the position of master mechanic in place of Mr. Chrysler. Mr. H. Otway has been appointed general foreman on the Chicago & Alton, with office at Roodhouse, Ill. Mr. J. H. Brewer has been appointed roundhouse foreman on the same road at Glenn, Chicago, in place of Mr. A. G. McLellan, resigned, and Mr. R. W. Moore has been appointed roundhouse foreman on the same road, with office at Slater, Mo., in place of Mr. Otway, promoted.

Mr. A. G. Trumbull, mechanical superintendent of the Erie at New York, has been appointed assistant to the general mechanical superintendent at New York. Mr. E. S. Fitzimmons, mechanical superintendent of the Ohio division at Cleveland, Ohio, has been appointed mechanical superintendent of the Erie division at New York. Mr. Charles James, master mechanic at Jersey City, N. J., succeeds Mr. Fitzimmons, and Mr. F. H. Murray, master mechanic at Port Jervis, N. Y., succeeds Mr. James. Mr. George Thibaut, general foreman at Susquehanna, Pa., succeeds Mr. Murray. Mr. T. S. Davey, master mechanic at Stroudsburg, Pa., has been appointed shop superintendent at Buffalo, N. Y., car shop, and Mr. W. H. Snyder, general foreman at Stroudsburg, succeeds Mr. Davey.

Our old globe wandering friend, W. D. Holland, has just arrived in the Land of the Free after an absence of about a year. His latest experience was in Cuba, where he filled the position of master mechanic as long as he could stand the strenuous life. After resting in Missouri for a few weeks he will be off again to some out of the way place where a good master mechanic is needed to straighten things up. Mr. Holland says there are two personages whose reputation he always holds up wherever he may wander. They are the Pope and Angus Sinclair, a curious combination. Mr. Holland is very frank in telling that RAILWAY AND LOCOMOTIVE ENGINEERING has done more to help railway mechanical men than all the other publications combined.

At a recent meeting of the Board of Directors of the Westinghouse Air Brake Company held at Wilmerding, Pa., Mr. Henry Herman Westinghouse was elected president to succeed his brother, the late George Westinghouse, founder of the Air Brake Company and numerous other Westinghouse interests. Mr. H. H. Westinghouse was born at Central Bridge, Schoharie Co., New York, in 1853. He attended the schools of Schenectady, and later entered Sibley College of Engineering at Cornell University, Ithaca, N. Y.

Like his brother, Mr. Westinghouse inherited from his father a fondness for mechanics and invention. He invented the well-known high-speed, single-act-

HENRY H. WESTINGHOUSE.

ing Westinghouse steam engine for the manufacture of which the Westinghouse Machine Company was organized in 1880. This is said to have been the only commercial steam engine invented by any of the Westinghouse family. In 1873 George Westinghouse

TOM R. DAVIS.

invited his younger brother to Pittsburgh to assist him in the management of the Air Brake Company, with which organization he has been connected ever since, for many years past being its first vice-president, and has been prominently identified with several other of the Westinghouse industries. Mr. Westinghouse has always taken a great personal interest in the affairs of the Air Brake Company's employees, being an active member of the Veterans' Association of that company, and instrumental in the promotion of the welfare work and pension plan so successfully exploited by this company. Mr. Westinghouse was also the organizer, and for a number of years, the guiding spirit in the management of the Westinghouse Church Kerr Company. In his profession of mechanical engineer, Mr. Westinghouse ranks very high, his particular gift being the design of machinery in which branch he is considered an expert.

He is quiet, unassuming and singularly democratic with the men in the shop and is known by practically all of the employees. He was a particularly intimate associate of his late brother and was his most faithful lieutenant in the management of his numerous affairs.

OBITUARY.

Tom R. Davis.

Mr. Tom R. Davis, mechanical expert of the Flannery Bolt Company, of Pittsburgh, died at his home in Dravosburg, Pa., on October 12, 1914, after a lingering illness of many months. He was born in Allegheny City, Pa., July 13, 1854, being the only child of the late Captain Joseph H. and Mary Wallace Davis. Was educated in the public schools of that place, and in 1872 began work as machinists' apprentice with the Allegheny Locomotive Works (now the Pittsburgh plant of the American Locomotive Company). In 1875 he was fireman on the P. F. W. & C. Railway, and the next year was promoted to engineer. In 1877, entered the employ of Crosby Steam Gage & Valve Company as special salesman, leaving that company in 1880 to accept the managership of the Monongahela Manufacturing Company, of Monongahela City, Pa. In 1883 he returned to work for the Crosby interests, leaving them in 1892 to enter employ of the Garlock Packing Company at Pittsburgh as mechanical expert. In 1898 he entered the employ of Homestead Valve Manufacturing Company, leaving that company in 1904 to enter employ of the Flannery Bolt Company as mechanical expert, which position he occupied at the time of his death. He is survived by his wife, Mrs. Mathilda Horner Davis, and three children, Joseph H., T. Randolph, and Mrs. J. W. McConnell. Mr. Davis was a member of Lodge No. 337 F. & A. M., of Brownsville, Pa.; Past Eminent Commander of St. Omar Commandery No. 7; K. T., of Brownsville, Pa., and a member of Lodge 455, B. P. O. E., of Monongahela.

June Convention Again Going to Atlantic City.

The joint committee of the Master Car Builders' and of the Railway Master Mechanics' Associations met in New York on October 22 to consider and settle upon the place for holding the conventions of the associations next year. A committee of the Railroad Supply Men's Association also took part in the deliberations. Intimations were given that invitations were given by business representatives from Atlantic City, N. J.; Washington, D. C.; Chicago, Ill., and San Francisco, Cal., who were on hand prepared to show forth the advantages of the cities they belonged to as convention headquarters. The representatives from all these places were given the opportunity to debate upon the merits of the various cities and then voting began. It proved to be rather protracted, but it resulted in Atlantic City being again chosen by a majority of one vote.

Considerable pressure was put upon the joint committee to vote in favor of San Francisco, but the length of the journey to the Pacific Coast and return deterred the members from voting to go there. While many of the committee personally favored going to San Francisco, they concluded that few of the general members would undertake that long journey and that a small convention would answer the roll in that far-away city. Consideration for the best interests of the two associations and the convenience of the railroad supply interests turned the scale in favor of Atlantic City.

The Locomotive Up to Date.

Locomotive Engine Running and Management, by Dr. Angus Sinclair, has been thoroughly revised and brought up to date by the author, and will be ready for sale in time to take its place as a Christmas present, a favor it has performed for many an engineman who has now reached the position of an executive officer. It is doubtful if any book ever published has done more than Locomotive Engine Running to raise enginemen up the ladder that reaches the top. Ambitious enginemen and others should lose no time in sending in their order for the new edition.

Whatever Thy Hand Findeth to Do.

To make a good mechanic, the heart and head and hand must work together. That rule holds good with all railway men from the trackman to the president. It does more than anything else to raise men from lowly to superior positions. The heart desires, the head plans and the hand executes. Along with that rule, it is well to observe another wise injunction—whatever the hand findeth to do, do it with all thy might.

Progress of Locomotive Engineers.

In discussing the causes of railway accidents and comparing the appliances used in the practical operation of railways in different countries, Charles F. Adams, of New England, said: "There is one element which can never be left out of account. The intelligence, quickness of perception, and capacity for taking care of themselves—that combination of qualities, which, taken together, constitute individuality and adaptability to circumstances—vary greatly among the railway employees of different countries. The American locomotive engineer is especially gifted in this way. He can be relied on to take care of himself and his train, under circumstances which in other countries would be thought to insure disaster.

"While American locomotive engineers can confidently invite comparison between their own mechanical and intellectual attainments with those of compeers in any nation under the sun, there still remains ample room for improvement. There is too little ambition among the men as a whole to excel in knowledge of their business. If they are not advancing as a class they are retrograding—going backwards. There is too great a tendency to depend on organization for progress instead of individual effort. The engineer who looks back to associates of a generation ago, and complacently asserts, we know as much as they did, but no more, implies the assertion that his class is going backward. On very few railroads and only in rare instances can this grave charge be made, that the engineers are falling behind in the intellectual race."

As President Duntley Sees Foreign Business.

There are few keener observers of men, things and mechanical operations than our stalwart friend, Mr. W. O. Duntley, president of the Chicago Pneumatic Tool Company, who has recently visited Europe and has noticed many interesting things about the war and the industrial situation. He arrived in England just a few days prior to the outbreak of hostilities between Austria and Servia, followed later by the break between Germany and the Allies, and he witnessed a great deal of the excitement during the early stages of the war and the preparations that were made for it.

He reports that while business was very much demoralized in the first few days of the war, the requirements of the Navy and the War offices grew so brisk and heavy that as far as the products of the Tool Company were concerned, business has resumed its normal condition. Fortunately all of the foreign offices of the company were well stocked with goods when the war broke out, which has enabled them to take care of the sudden and increased demands. The shipments to the English company are greater now than ever before and the demand for pneumatic tools and practically all of the labor saving devices made by the company are greater now and will continue to increase in practically all of the countries now involved in the struggle. Compressed air and electrical labor-saving machinery is of first importance in government shipyards, railroads and other large industrial concerns which are busy at present in the manufacture and repair of warships, firearms and other munitions of war, so that the European business is now on the whole greater than it has been for years.

The unprecedented destruction that is now going on impressed Mr. Duntley with the great volume of business that is in store for American manufacturers of machine tools and all kinds of machinery as soon as the war is over.

Exaggeration on the Mosquito.

Among the prominent speakers at the Boiler Manufacturers' Convention, held in New York lately, was Mr. W. H. Broderick, of Muncie, Ind., who made a stay in a Jersey City hotel. His experience in New Jersey moved him to say that a gang of boiler makers were working in a big boiler in the yard of the plant, and after tackling their dinner pails at noontime took a nap in the boiler in the heat of the day in the half hour coming to them till the whistle blew.

"While they were snoozing a cloud of Jersey mosquitoes attacked the boiler and bored through it from the top to get at the sleeping workmen. The men were awakened by the steel borings falling in their faces, and seizing their hammers, they clinched the skeeters' bills on the inside of the boiler top, and the mosquitoes, enraged with the pain, flew off with the men, boiler and all, over the Hackensack meadows and kept them up in the air till they, the mosquitoes, were exhausted—which was in about six or seven hours."

Enough for One Day.—All day James had played truant from school, and when next morning the irate master raised his cane threateningly James burst into a flood of tears. "Please don't lick me, sir!" he sobbed. "And why should I not lick you, pray?" thundered the schoolmaster. "W'y, sir, 'cos I think I've 'ad enough!" gasped James. "Yesterday the boy I played truant with and I fell out, and he licked me; and a man we threw stones at caught and licked me; the driver of a cart we hung on to licked me; the owner of a cat we chased licked me. Then, when I got home, mother licked me; and after that father licked me; and then mother licked me again for calling her a sneak for telling father."

RAILROAD NOTES.

The Delaware, Lackawanna & Western is said to have ordered 13,000 tons of rail.

The Chicago & Alton, it is reported, has ordered 7,200 tons of rails from the Illinois Steel Co.

The Penick & Ford Tank Line is in the market for 50 to 100 tank cars, 8,000 gal. and 100,000 lb. trucks.

The Manufacturers' Ry. (St. Louis) has two 50-ton switchers for sale. Both are in first class condition.

The Ligonier Valley, it is said, has completed plans for several shop buildings, to be erected at Ligonier, Pa.

Okura & Company, New York, are reported to be asking prices on a thousand 30 and 40-ton cars for export.

The Lehigh & New England shop buildings to be built at Pen Argyl, Pa., are said to require 600 tons of structural steel.

The Merchants' Despatch Transportation Co. is to fabricate 2,000 underframes for the New York Central & Hudson River.

The Cuban-American Sugar Company, of New York, has ordered a Mogul locomotive from the Baldwin Locomotive Works.

The Toledo, St. Louis & Western has placed an order for 1,000 tons of rails with the Carnegie Steel Company, it is reported.

The Atchison, Topeka & Santa Fe is making surveys for the construction of a railway from Santa Fe to Taos, N. M., it is said.

The Nashville, Chattanooga & St. Louis, it is said, is contemplating the purchase of ten Mikado and seven Pacific locomotives.

The Southern has awarded a contract for 950 torns of steel for a viaduct over the Tye river, Georgia, to the Pennsylvania Steel Company.

The Louisville & Nashville has work under way on the construction of a 12-stall roundhouse and repair shops in the yard at Lexington, Ky.

The Louisville & Nashville has ordered 1,000 underframes for application in its own shops. This road is planning to place an order for 870 cars soon.

The Southern Pacific is reported in the market for 16 coaches, 6 combination passenger and smoking cars, and 2 combination passenger and express cars.

The Union Terminal Company has ordered 1,285 tons of steel from the American Bridge Company to be used in the new union station at Dallas, Tex.

The Minneapolis & St. Louis has awarded a contract for the erection of a passenger station at Albert Lea, Minn., to C. F. Mayer & Co., Humboldt, Ia.

The Oliver & Smder Steel Co. has 200 cars for sale which are offered subject to prior sale at $150 each, net cash. These cars are in good M. C. B. condition.

H. E. Prindle, Montreal, Que., is preparing plans for the new Union Station to be created at Quebec for the Canadian Pacific and Transcontinental Railways

The new union station at Memphis, Tenn., to be occupied by the Illinois Central, Chicago, Rock Island & Pacific, and St. Louis & San Francisco has been opened.

The American Construction Company has been awarded the contract for the construction of steel bridge, bascule type, across Buffalo bayou by the International & Great Northern.

The Pennsylvania Lines West will be in the market in the near future, it is said, for machine tools. They will be installed at the Indiana Harbor, Ind., shops, which are now nearing completion.

The Delaware, Lackawanna & Western is said to have awarded 3,000 tons of rails to the Bethlehem Steel Company, 2,000 tons to the Pennsylvania Steel Company and 8,000 tons to the Lackawanna Steel Company.

The Western Maryland has let a contract to the Enterprise Construction Company, Elkins, W. Va., to rebuild the freight depot at Elkins at an estimated cost of $6,000. This depot was recently damaged by fire.

The Southern has given a contract to R. V. LaBarre, Birmingham, Ala., for a new frame passenger station at Hawkinsville, Ga. The present combined passenger station and freight house will be remodeled and used exclusively as a freight house.

The Atlantic Coast has given a contract

to E. W. Parker, Curry building, Tampa, Fla., to erect a storage building at Jacksonville, Fla. This road has work now under way, it is said, on the foundations for an addition to the machine shops at Waycross, Ga.

The Central of Georgia has given the Union Switch & Signal Company a contract for installing a mechanical interlocking plant at the west end of receiving yard at Macon, Ga., together with automatic block signals between Macon Junction and Terra Cotta.

The Minneapolis, St. Paul & Sault Ste. Marie will have track laid in October on an extension from a point four miles west of Makoti, N. D., on the Plaza line, west to Van Hook in Mountrail county, 23 miles. The line is eventually to be extended further west to Fairview, Mont.

Accidents on Steam Railways.

The number of persons killed in train accidents during the months of January, February, and March, 1914, as shown in reports made by steam railway companies to the Interstate Commerce Commission under the accident law of May 6, 1910, was 120, and the number of persons injured, 2,371.

The total number of casualties of all classes reported amounted to 2,108 for persons killed and 42,414 for persons injured. This statement includes 1,909 persons killed and 15,364 persons injured as the result of accidents sustained by employees while at work, by passengers getting on or off cars, by persons at highway crossings, by persons doing business at stations, etc., as well as by trespassers and others; and also 79 persons killed and 24,679 persons injured in casualties reported as "industrial accidents."

Railway Extension in Chile.

The Northern Longitudinal Railway of Chile is now in full operation, the work being entirely completed connecting Pisagua in the north of Chile with Valparaiso, Santiago, and Puerto Montt, well to the south of the country, a distance of about 1,960 miles. The new portion from Iquique to Calere, a distance of about 750 miles, has been constructed within the past three years; has cost about $40,000,000; and is to be operated for 50 years by the Chilean Northern Railway Company, Calera, Chile, an operating company organized by the Howard syndicate, which supplied the money under a guaranty from the Chilean Government. The gauge of this line is 3.28 feet, while the gauge of the old portion of the Longitudinal Railway is 5 feet 6 inches.

Safety on the Pennsylvania.

Announcement is made that the lines of the Pennsylvania Railroad System—East and West—in the six months ending July 1, 1914, carried 87,000,000 passengers, and not one of them was killed in a train accident. On the lines east of Pittsburgh no passenger has been killed in a train accident since 1912. During this period these lines alone have carried more than 161,000,000 passengers.

New Cars on the Denver & Rio Grande.

Ten new all-steel combination mail and baggage cars have just been purchased by the Denver & Rio Grande Railroad and are now in service on that road in through runs between Denver, Salt Lake City and Ogden. The cars are of the latest type in every particular and are built in strict accordance with specifications recently adopted as standard for mail cars by the Federal Government, being 70 ft. long inside, 30 ft. of which is taken up as mail room and 40 ft. for baggage. The interior fittings are of steel design with the most modern appliances for heating, lighting and ventilation, and are equipped with all-steel trucks, steel wheels and high speed brakes.

"Haits" the Railroad.

The following letter was written by a Iowa farmer to the claim agent of the Rock Island Railroad:

"For some weeks past my dog has been in the habit of sicking himself unto the cars as they sped past my place, and he never harmed no one by so doing, nor never would, as I have known him from a child, very peaceful and fond of young children, and awful fond of the butcher's shop, before where he would sit up on his hind legs and beg with a voice of joy for anything he requested. When he would run at the cars, he would act savage, but still would niver injure the train by word or deed if you had a hundred trains whizzing past by day or nite.

"But what does the fireman on the Stick in the Mud Express do but entices my dog to close quarters and throw chunks of coal and squirts hot water upon him, which he tells me in a blith and frivilous tone is to take the bark off my dog. That is what makes me hait your railroad, and that is not all by a long choke, for yesterday they misled my dog and got him in front of the engine, when they pulled her wide open and smashed my dog in a way that hurts your rode, and causes it to be looked at askance by every thinking tax payer and mother. I say fy on such a rode as yours, with its sanwiches that have a thin rim of ham around the aige, so when you lock your teeth with it you get left, and the rode has got your money in Dennis. Fy on the whole thing is what I say."

Books, Bulletins, Catalogues, Etc.

The Future of the Railroads

Mr. Roger Babson, president of the Babson Statistical organization, Wellesley Hills Station, Boston, has published a book on the above subject based on various reports and letters issued from time to time by himself. The book which extends to 130 pages is full of valuable data in regard to the important questions affecting the American railroads. The author contends that the railroads are between three millstones—the shippers, represented by the government, the investors, represented by the directors, and a vast army of employees, who are better organized than either of the other two combinations. To show the probable outcome of the struggle is the purpose of the book. Its logic is convincing and it is pointed out very clearly that instead of the federal government arbitrarily determining rates, and the getting what it can for the people in the way of service, it should first demand better service and improved conditions, allowing the railroads such a rate as will properly distribute the expenses among all persons benefiting therefrom. The reports and opinions are given in confidence to subscribers only.

Reactions.

Reactions, a quarterly publication devoted to the science of aluminothermics, and published by the Goldschmidt Thermit Company, is just issued for the third quarter in 1914, and contains much valuable information in regard to a large number of welds made in locomotive repair work in various railroad shops. Considerable improvement in the methods used have been made with the result that welds can be made considerably faster, more easily and cheaply than they could a year ago. With the appliances perfected as they are, there is very little chance for the human factor in Thermit welding as the operator simply has to follow his instructions and if he does the same thing in the same way he is bound to get the same good results every time. Exact expert instruction is supplied and operators are carefully taught how to do the work. Copies of the issue or any of the company's pamphlets may be had on application to the main office at 90 West street, New York.

Licensing Professional Engineers.

A very able letter has been written by Mr. D. F. Crawford, general superintendent of motive power, Pennsylvania Lines west of Pittsburgh, to the members of the Engineers' Commission of the State of Pennsylvania, relative to a bill to license professional engineers. Mr. Crawford contends that it will be impossible for any commission to determine the capability of any engineer in his particular line of endeavor, as his capability is a question of his experience and common sense, and the using of these two attributes determines his judgment in the solving of engineering problems, and the correctness of his judgment does not necessarily depend upon his ability to solve catch problems or involved examples in calculus. Mr. Crawford cannot conceive of how the public would be benefited by an act of this kind, and it is to be hoped that the Governor of Pennsylvania will coincide with the sensible views contained in the document.

Jessop's Steel.

A finely illustrated pamphlet of 32 pages has just been issued by William Jessop & Sons, the well-known steel manufacturers, with offices at 91 John street, New York. The pamphlet is very instructive and of real interest to all in any way interested in high grade crucible steel. It need hardly be said that Jessop's steel is made in Sheffield, England. The firm is one of the oldest and largest engaged in the manufacture of steel having been established in 1774. The steel is manufactured from the very best brands of Swedish irons, of which the Jessop's control the entire output. It is generally admitted that steel made from the best Swedish irons is of marked superiority in the making of fine tools. The long experience and eminent success of the company in their chosen field of manufacturing fine steel has attracted world-wide attention, and it is conceded that the material and methods used by the enterprising firm imparts a quality to their products which can be derived from no other process.

Safety.

The official organ of the General Safety Committee of the New York Central Lines is in good hands. Month after month it presents impressive scenes of how easy it is for a careless man on a railroad to get killed. As is well known the majority of accidents that do occur can be prevented if every employee will co-operate by stamping out the unsafe practices which are indulged in by some, and which are the cause of the greatest percentage of injuries received by employees and others. The committee referred to was organized in May, 1912, and it would take several volumes to record their work. Suffice it to say that there is now all along the lines a feeling of deep earnestness in safety methods of operation. The percentage of casualties has been reduced in a marked degree, and it looks as if in a few years more railroading will be as safe as any other occupation.

That ten thousand people have been killed on American railroads every year for some years is a disgrace to civilization, and in some respects is worse than a German battalion moving in close column against French artillery. But both these appalling conditions cannot last forever. The future safety of American railroads is full of promise, and committees like the one that we have referred to deserve imitation which is the highest kind of praise.

American Vanadium Facts.

The claim that vanadium is the most powerful metal yet discovered for alloying with steel is amply borne out by the monthly publication of *Facts* by the American Vanadium Company, Vanadium Building, Pittsburgh, Pa. In last month's issue among other interesting matter a table giving a summary of the comparative service of 100 pairs each of oil-treated chromo-vanadium and oil-treated carbon rolled steel wheels and steel tired wheels, running under practically identical conditions on the Grand Trunk Railway, is of particular interest. In comparison with the oil-treated vanadium wheels, the oil treated carbon wheels shelled three times as much, and the steel tired wheels five and a half times as much. Other data is also equally convincing in regard to the important wearing quality imparted to steel when mixed with certain quantities of vanadium. Copies of these service records may be had on application. Write to the company's office at Pittsburgh for copies.

Dixon's Pencil Geography.

The high road to popular favor is to give humanity something for nothing. The Joseph Dixon Crucible Company, Jersey City, knows this already and practice it and there is before us the new and fifth edition of Dixon's Pencil Geography. The booklet is a miniature model of the old-fashioned geography in common use forty or fifty years ago and is intended primarily for school use, although the information it contains relative to pencil production is of general interest. A copy will be mailed free upon request to any reader of "Graphite," the company's monthly publication, which in itself is always of interest, and all of Dixon's graphite publications are sent free upon request. A word to the wise is enough.

Mine Hoist Equipment.

The General Electric Company are surpassing themselves in the beauty and elegance of their publications. Last month's Bulletin is devoted to power and wiring department, especially electric wire hoisting. For making recommendations and estimates on this class of work the company maintains a staff of engineers trained in and devoting their time to the practical and technical aspects of mine hoisting. The illustrations are admirable and the descriptive letterpress is excellent. Copies may be had on application to the company's principal offices, Schenectady, N. Y.

Index of Railroad Club Proceedings.

The index of papers and subjects discussed by railroad clubs for the year, May, 1913-14, has just reached our desk. An unusual feature of the index is a historical sketch the principal part of which reads:

The history of railway clubs in the United States began with what was known originally as the Master Carbuilders' Club, formed by the late Leander Garey and his associates in the winter of 1871 and 1872. In 1887 the name was changed to the New York Railroad Club.

From this humble beginning of a score or more members, that club has steadily grown and advanced until its membership today is something near sixteen hundred.

The formation of this clubs seemed to pave the way for similar organizations and other railway clubs were organized in different parts of the country, until today there are twelve railroad and railway clubs in the United States, holding periodical meetings during the season extending from September to May inclusive, and having an estimated membership of nearly seven thousand members.

The work and growth of these railway clubs is known very generally throughout the country by nearly all railway men and many others outside of the immediate railway circle.

Fire Shovels.

The malleable iron fire shovels manufactured by the National Malleable Castings Company, at Sharon, Pa., and Melrose Park, Ill., are the subject of circular No. 53, issued by the company, and should be in the hands of all interested. The shovels are light and durable, and strong enough to break up lumps of coal without damage to the shovel. They are stronger than pressed steel, because they never rust. They have stood the test on many railroads and are seen almost everywhere in caboose car stoves, depots, section houses and other places where coal is burned for heating purposes. Send in your orders. The winter is coming.

"The best government is that which governs the least," was a wise saying of Thomas Jefferson, which has been badly distorted by modern politicians. Unfortunately the prevailing sentiment of callow members of Congress is that all affairs of men, including the management of ordinary business, demands the interference of political meddlers and the country suffers in consequence.

Statement of Ownership and Management of RAILWAY AND LOCOMOTIVE ENGINEERING, *published monthly at New York, N. Y., required by the Act of August 24, 1912.*

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Known bondholders, mortgagees and other security holders, holding 1 per cent. or more of the total amount of bonds, mortgages, or other securities: None.

HARRY A. KENNEY,
Gen'l Mgr.

Sworn to and subscribed before me this twenty-eighth day of September, 1914.

OLIVER R. GRANT.

Notary Public No. 1398, *New York County. New York Register* 5128. *Commission expires March* 30, 1915.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVII. 114 Liberty Street, New York, December, 1914. No. 12

New Type of High-Speed Electric Passenger Locomotives on the New York Central Lines

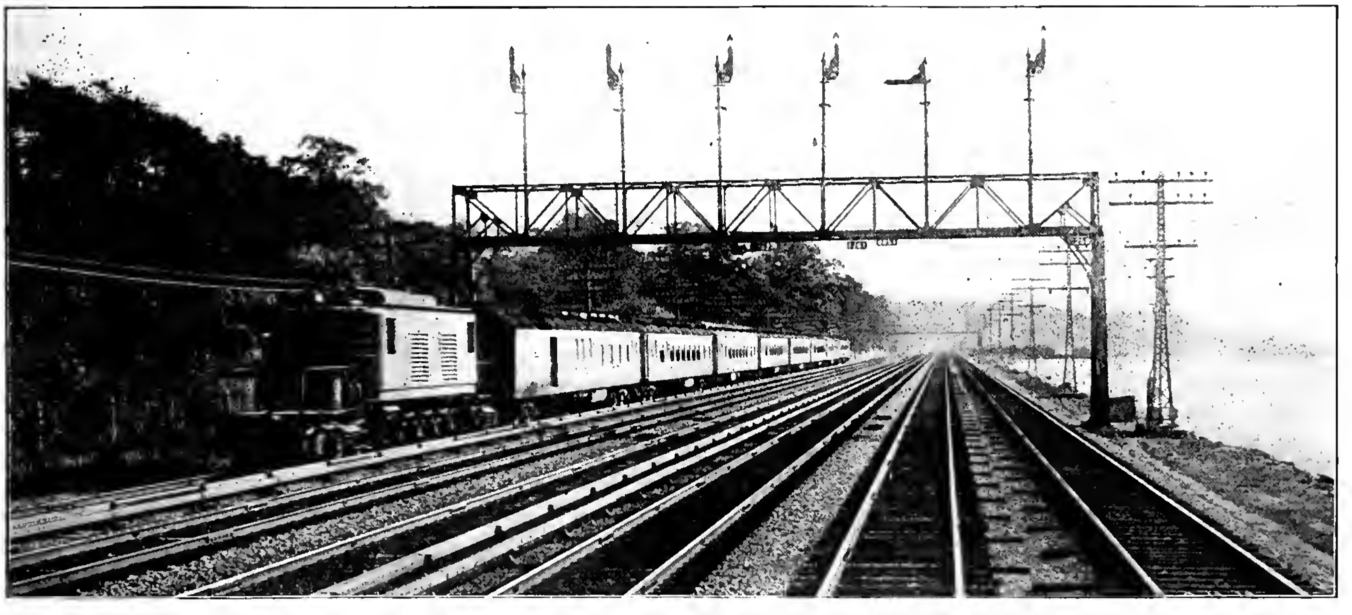
On the New York Central Lines sixteen high-speed electric passenger locomotives have been placed in main line passenger service during the year. This type of locomotive is the most powerful electric passenger locomotive thus far constructed and is capable of continuously hauling a train of fourteen steel Pullman cars at a sustained speed of sixty miles per hour. With lighter trains the maximum speed of these locomotives is eighty-five miles per hour. These speeds and capacity have been repeatedly attained in tests made both on the experimental track maintained by the railroad company near Schenectady, N. Y., and also on the electric division before the locomotives were put in regular service.

The electrical features of these locomotives are generally the same as in the original electric locomotives first operated by the company eight years ago. The principal change is in the mechanical arrangement of the wheels and trucks. In the thirty-five locomotives originally placed in service there were four driving axles set in a rigid wheel base, and the guiding of the locomotives was accomplished by two-wheel pony trucks at each end. These locomotives weigh 100 tons and are hauling eight Pullman cars at a speed of sixty miles per hour.

The next development was the placing of four-wheel bogie trucks under each end of a locomotive for the purpose of improving the riding qualities at high speeds. Of this class twelve locomotives were built, and they weigh 122 tons, their hauling capacity being about the same as that of the earlier electric locomotives.

The new locomotives, as shown in the accompanying illustration, weigh 132 tons, and the great increase in capacity, compared with the comparatively slight increase in weight, is due to the fact that motors have been placed on the axles of the leading and trailing bogie truck wheels, thus avoiding all dead weight, all the wheels being driving wheels, and the entire weight of the locomotive being thereby available for producing tractive effort, or draw-bar pull.

The view shows one of these locomotives attached to what is known as the Twentieth Century Limited, the leading train of the New York Central Lines. At the point where the picture was taken the train was on the six-track section of the New York Central & Hudson River Railroad, near Riverdale, on the Hudson division of the first portion of the fast run between New York and Chicago. The picture also shows a type of perfect modern track construction, including rock ballast, electric automatic signals, electric cables for the transmission of power and third-rail operation of trains, and this combination of motive power and appliances may be said to represent the highest development in railroad building and train operation, particularly in electric locomotive power.



NEW HIGH-SPEED ELECTRIC PASSENGER LOCOMOTIVE WITH TRAIN ON THE NEW YORK CENTRAL LINES.

The World's Railways.

According to the latest completed reports of the United States Bureau of Railway News and Statistics, it appears that the United States again leads the world in growth in railways. The total length of railways amounted to 670,523 miles, showing an increase of 2.5 per cent. over the previous year. North and South America account for almost two-thirds of this gain. The United States are an easy first with nearly 250,000 miles, while the whole of Europe has only 212,427 miles. Ecuador leads the way as regards expansion during the last five years, with 106.5 per cent.; then come Africa, 39.6; Australia, 20.4; Asia, 13.3; North and South America, 8; the United States, 7; Europe, 5.2; while the gain to the whole world in the quinquennial period amounted to 9.9 per cent.

Belgian Railways.

The eyes of the world are at present turned towards Belgium, and it is interesting to glance briefly at the degree of perfection which the railway equipment had reached previous to the appalling calamity which has fallen upon the country.

When one bears in mind the generally flat character of the country of Belgium, one scarcely would look to the railway system of that kingdom for the most powerful coal-burning express locomotive in Europe. Yet such is the case. This distinction has been gained by means of the mammoth Pacifics of the 10 type designed by Monsieur B. J. Flamme, the eminent locomotive engineer, and the chief of the mechanical department of the state railway system. These creations are four-cylinder simples, and have since been divided officially into two classes—those built previous and subsequent to the year 1912 respectively. While the last-named class has slightly less aggregate heating surface, and is nearly four tons lighter, the tractive effort is identical in each instance.

The following details refer to the most recent expression of this design. The diameter of the cylinders is 19.685 ins., while the stroke is 26.98 ins. The total heating surface is 3,246.3 sq. ft., of which aggregate the superheating surface is 667.36 sq. ft., while the firebox area is 49.29 sq. ft. The drivers are 78 ins. in diameter, and each driving axle carries 18,699 lbs., giving a total weight of 56,097 lbs. available for adhesion. The total weight of the engine in running order is 96.45 tons, while the tractive effort is 33.435 pounds.

The six-wheeled tender carries 7 tons of coal and 4,872 gallons of water. These Pacifics are engaged in the heaviest and fastest mail service. The average weight of the train behind one of these engines is some 400 tons, but often it is increased very appreciably. Possibly the stretch upon which these monsters are able to show their paces to the best advantage is the 78 miles between Ostend and Brussels. This run is made in 90 minutes, including two stops, at Grand St. Pierre and Bruges respectively. Upon the reach of 25 miles between these two stations, where the conditions are peculiarly adapted to fast traveling, it is no unusual circumstance for this train, even with a load of 450 tons behind the locomotive, to notch 76½ miles an hour, while on the other parts of the journey 62 to 65 miles an hour are sustained with ease.

Economy on the Pennsylvania.

It is reported in the *North American* that the Pennsylvania Railroad Company had decided to stop making minor alterations to steam locomotives as in the past, and determine on three permanent types, making the parts in each so as to be interchangeable. The reason given being that considerable economy would result, since the heating plants that had been put in at Altoona at great expense for the case hardening or toughening of the parts would give these parts so much more endurance than heretofore. We have no desire to state that our esteemed contemporary is misinformed, but we know from long experience that the Pennsylvania will adopt new means and methods when their practicability becomes apparent.

Safety First on the New Haven.

Large and enthusiastic meetings are being held at all of the division points on the New Haven. Last month at Keith's Hall at Providence, over 200 were turned away, the hall being filled. At New London similar experience was had at Lawrence Hall. At these meetings were trackmen, shopmen, station employees and representatives of every branch of the operating and mechanical departments. Addresses were made by the Division Superintendent and other officers upon the importance of safety and the need for co-operation to reduce the number of accidents.

Metal Ties in Switzerland.

In 1881 metal ties were first used in Switzerland, and they have to a large extent replaced the wooden tie in that country, over seventy per cent. of the ties used on the Federal Swiss railway system being of metal. The ties are 9 feet long, by 9¼ by 5¼ inches, and weigh 160 pounds. The selling price is $2.30 as compared with $1.50 for oak ties. The metal ties have up to the present year been largely supplied from German foundries.

Work on the Canadian Northern.

Grading has been completed on the Canadian Northern Railway from Montreal to the harbor of Vancouver, and it is expected that this length will be completely railed before the beginning of the new year. Two gaps each of about 50 miles in length are waiting for steel in British Columbia, and track-laying is going on at the rate of about two miles per day. There are also three bridges to be completed, viz., at the Back River, at the crossing of the Chat River above Ottawa, and a third in British Columbia. The substructures for the three have been finished, and the superstructures will be completed in about a month. The company's big undertaking at Mount Royal has progressed very favorably. Over a mile of tunnel has been excavated to full cross section and about 600 feet of lining has been put in.

Railroad Traffic.

A larger tonnage movement is being handled by Eastern roads than last year, the principal gains being in flour, grain and miscellaneous freight. The latter is chiefly made up of army equipments being sent to the seaboard for export to Europe. There is also a very large traffic in horses, which has helped to offset the loss in live stock as a result of the closing of the stock yards for some time in November. The opening of the stock yards is adding greatly to the traffic. The coal movement is lighter, but this has undoubtedly been owing to the continuance of mild weather.

Oil Burners on the Grand Trunk Pacific.

Oil burning locomotives will be used, according to statements made in an official interview, by the Grand Trunk Pacific on its transcontinental route. The company is preparing contracts for large developments, and oil storage facilities are receiving considerable attention. The terminals at Prince George, Endako, Smithers and Pacific are among the divisional points where storages will be established.

Let Us Have Peace.

The superintendent of a Southwestern railway has issued orders to train crews to cut out the clanging of bells, the tooting of whistles, the sudden popping off of steam by engines close to sleeping cars, the shouting back and forth in the yards that train crews seem to think essential, and the selection of the aisle for nocturnal conversation by the porters—all these too familiar foes of sleep are to be eliminated.

New Electric Railway in the Alpine Mountains

In 1912 a company was organized in Switzerland to construct a new electric railway from the city of Chur, the capital of the Canton of the Girons in Switzerland, to what is said to be one of the most enchanting of the Alpine resorts—Arosa Meadows, a veritable gem of tranquil beauty. The starting point of this newest electric Alpine railway is in closest vicinity to the railroad station at Chur, situated at an altitude of 1,295 feet above sea level. The terminal of the line, which is a meter gauge, adhesion railway, at Arosa, is over 6,000 feet above sea level.

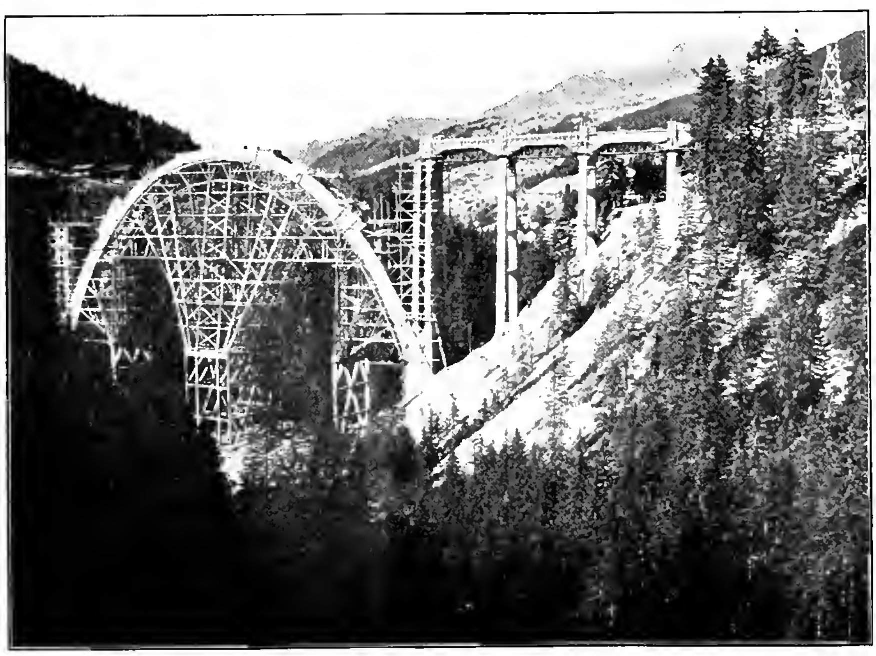
On leaving Chur the valley begins to assume an aspect of wild grandeur. Gorge follows gorge, and the foaming waters of the Plessur river thunder in wild anger below. Bridge follows bridge, and although the river is crossed but once—at Langwies, there are between Chur and Arosa not fewer than twenty-seven bridges of stone, three of iron and two of concrete, as well as nineteen tunnels with a total length of 7,800 feet.

Before reaching the village of Langwies, a boldly constructed arch comes in view. This is the viaduct of Langwies, the most prominent single feature of the Chur-Arosa railway, and one of the most remarkable bridges in Europe. The main arch of this bridge, which, when completed, will be the second largest masonry arch in the world, has a clear span of 315 feet, and a height of 140 feet. The viaduct itself measures 960 feet in length and shows a grade elevation of 207 feet above the valley.

The material of the arch and the pillars contains portions of iron, which are practically forming the invisible skeleton of the same. The principal building material consists, however, of a combination of gravel, cement and sand, the durability of which has been found far superior to stone, as a stone bridge necessitates a very solid and heavy construction, whereas a structure of this material can be made with safety much lighter. The viaduct of Langwies with its graceful and remarkably curved arch may look frail even to experienced engineers, yet with its new and scientific distribution of building material, it has been made perfectly safe and strong.

There are other remarkable viaducts on the line, the Calfries viaduct between Maladers and Cartiel, being another striking feature of the line. Two central arches with a respective span of 83 feet and 60 feet have been built of concrete blocks, and the four lateral arches of 40 and 20 feet each are of tamped concrete.

AROSA IN WINTER. TERMINAL OF THE CHUR-AROSA RAILWAY.



VIADUCT NEAR LANGWIES, IN GIRONS, SWITZERLAND.

The last station before reaching Arosa is Ruti. It is the finish of the famous bob-sleigh run Arosa and Ruti, and is a great pleasure resort especially during the winter. Nearby is the Schiesshorn, a majestic mountain pyramid of dazzling whiteness, but the whole region is full of unexpected and ever-varying wonders, and the new electric railway, which is being placed in operation during the present month, brings another exquisite vision in closer touch with the world.

Oilstones.

There are two or three varieties of oilstone. For general use, that known as Turkey oilstone is the best. The oilstone made from a kind of slate cuts more readily, but does not put quite so fine an edge on the tool as the harder stone, and wears away quicker. The stones are mounted in a block of wood, and furnished with a cover to keep out dirt and prevent the oil drying up. As tools of various widths have to be sharpened on the same stone, the center gets worn away more than the sides, and becomes unsuitable for sharpening a wide-cutting edge, such as a plane iron. To correct this the oilstone should be rubbed on a flat stone, such as a doorstep, kept well wetted with water during the operation, till the surface is perfectly flat. The oil used on the stone should be of the non-drying kind, otherwise it gets thick and interferes with the action of the stone on the tool. Animal or mineral oil alone should be used.

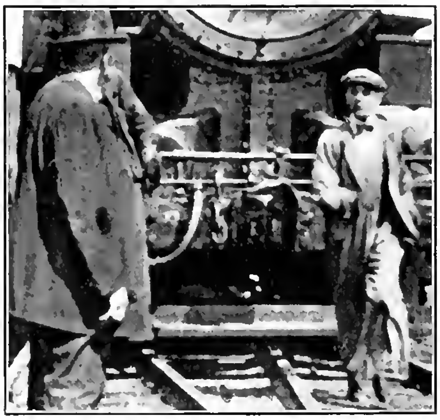
Safety First in Moving Pictures

A moving picture play produced for the New York Central Lines, and also arranged for presentation on the Santa Fe, Burlington & Quincy, and the Lackawanna, is not only a new departure in Safety First movement, but is by far the most impressive lesson ever taught to railroad men. While lectures, circulars, rules and placards have their uses, it is a well-known fact that railroad men who have themselves been in a disaster have learned a lesson that they never forget. Byron said that "shipwrecks are talked of by the survivors," and so are accidents on railroads spoken of by those who witnessed them, but were fortunate enough to escape safely. The New York Central Lines have taken a prominent part in the good work of keeping before the minds of their employees the incessant need of eternal vigilance looking towards safety. Mr. Marcus A. Dow, the head of the Safety Department, conceived the idea of presenting in a moving picture a series of common accidents strung together in a dramatic and stirring manner. The idea is Shakesperean in its intensity of presentation. Richard the Third of England sees the ghosts of all he murdered pass before him in a dream, and Mr. Dow, perhaps unconsciously imitating the great dramatic poet, puts his chief character, Steve Hill, a careless yard brakeman, to sleep, after he had been the means of seriously injuring a fellow workman, and in that sleep he gets a vision of what dreams may come. In his disordered brain Steve sees himself doing a number of things that he had been doing in his work—things which endanger life and limb. He saw himself caught between the drawbars of two cars. He saw himself tripping and falling between moving cars. Then he was knocked in front of an engine because he had stood on the wrong side of a push pole. Then he was knocked from the rear of a flying freight car, and finally he fell under the wheels of a string of freight cars and lost a leg. Then he awoke and the sweat was on him, awake to a sense of the awful risks he had been taking, awake to the crime of carelessness and all its grim consequences. Bill became a new man, a model man, the better class of the careful, alert and earnest railroad man.

STEVE HILL'S FATHER GETTING KILLED IN THE "MOVIES."

There is also a love story running through it, which, while it does not add to the impressive lesson taught in the appalling scenes, gives a pleasant finish to what would otherwise be a succession of startling incidents any one of which cannot fail to print itself indelibly on the spectator.

Mr. Dow has performed a notable service to the department which he so worthily conducts, and it is to the credit of the railroad company that he has been so generously supported in the work that he has undertaken. It need hardly be stated that it was necessary to secure the services of actors not only of training and experience, but also those who were familiar with railroad work. We had the pleasure of meeting some of them and were agreeably surprised at their intimate knowledge of railway appliances, but it must be remembered that actors, like lawyers, must know a little of everything and specialize on the work immediately in hand.



STEVE HILL, LIKE HIS FATHER, IS ALSO CARELESS, AND GETS REPRIMANDED.

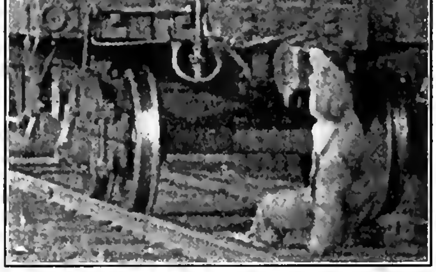
In this new departure looking towards a greater degree of safety there is a vast field for opportunity to educate the general public as well as the railway employee. In holding the mirror up to nature the moving picture is the consummation of the pictorial art, and if the traveling public could see themselves as the railway men sometimes see them, doubtless they would take a thought and mend their ways, and lessen the liability not only to annoyance to others, but frequently to disaster to themselves.

Prosperity and the Railroads.

Mr. S. H. Church, vice-president of the Union Steel Casting Company, of Pittsburgh, states that the low point of business depression was reached during October, and that improvement has now set in, which we all hope will go right on until normal conditions are again reached. If we would only realize that nothing has happened to us, all would be well, but nearly everything in this country is at a standstill because we are frightened. Here is nearly the whole of Europe in a state of war, with all that that implies, destroying not only hundreds of thousands of human lives, but also hundreds of millions in property, with all production stopped, while America is at peace with the whole world and is destroying neither lives nor property. We have the greatest crop in the history of our country, and everything is sound in our business conditions, with the whole world ready to buy our output. This situation gives America an advantage which has never been equalled, but it requires both brains and courage to rise to the opportunity. The whole trouble is that capital is the most timid thing in the world, and everybody is waiting for some one else to do something. American prosperity must always begin and end with the railroads, and if the Government would only clear the way for the railroads to resume their essential development, we would soon find every mill in America running to its full capacity, and our whole population in the midst of an industrial and agricultural prosperity which this country has never known before.

Railroads in Ecuador.

There is but one completed railroad in Ecuador, that between Guayaquil and Quito. Until this road was extended in 1905, Quito was, by modern standards, considered to be shut out from the world. Another road, the Ambato-to-Curaray Railway, 190 miles long, is under construction which will connect the Guayaquil and Quito Railway at Ambato with the easterly provinces of the republic. The last consignment of rails for this new road was expected about November. Two Baldwin locomotives have been received and other rolling stock has been ordered from the United States. The preliminary survey is nearly completed for still another railroad between Puerto Bolivar and Borja known as the trans-Amazon Railway. This road will connect the Pacific coast with the head of navigation on the Maranon River, the name by which the upper Amazon is known as it passes through the Peruvian Andes within a hundred miles of the Pacific Ocean.



STEVE HILL GETS A LEG TAKEN OFF IN THE "MOVIES."

Air Brake Association.

About twenty-five years ago the care of air brakes became such important work that agitation arose among railway men in favor of establishing an air brake organization where men particularly familiar with air brake mechanism might meet periodically and discuss subjects of mutual interest. This culminated in 1894 in the organization of the Air Brake Association, which has grown in numbers and influence so that its members are now considered the most influential officials regarding the operation and maintenance of air brakes.

The air brake has developed slowly from the simple apparatus that used straight air to push the shoes against car wheels, thereby controlling the speed of short trains in a very inefficient manner, to the modern automatic brake which does the work properly on any length of train and under the most trying conditions of speed and grades. Every advance made in train brake mechanism has been carefully studied by the Air Brake Association. Reports have been read about them and exhaustive discussions of details have served to keep railroad men generally informed on everything worth knowning about air brakes. The efficiency of the air brake and the extraordinary skill displayed in handling it, has been due in a great measure to the intelligent labors of the Air Brake Association.

A few particulars of the work done from the very beginning of the Air Brake Association will give you an idea of the proceedings of a particularly earnest and efficient body of experts.

At the first annual convention reports were read on Cleaning and Oiling Triple Valves; Air Pump Repairs; Maintenance of Freight and Passenger Train Brakes; Handling Freight or Passenger Trains Wholly or Partially Equipped with Air Brakes.

At the second annual convention, held at St. Louis in 1895, the following subjects were reported on and thoroughly discussed: Pump Governors and Air Gauges; Air Pump Piston; Care of Engineer's Brake Valve; Foundation Brakes; Care of Signal Apparatus and Conductor's Valve; Slid Flat Wheels; Driver and Engine Truck Brakes; Slack Adjusters; Handling Trains on Heavy Grades; Tests Made to Determine the Stopping Power of Engines Reversed, With and Without Use of Air Brakes.

The progress between the second and the twenty-first conventions reveals an immense amount of valuable work performed.

Opening of Railway in Constantinople.

Comparison between the customs of different countries always is interesting, says the *Valve World*, and now and then it may be instructive. A short time ago they opened a new street railway in Constantinople. The officials of the road assembled in a body and the populace was out in force. Prayers were offered by Mohammedan priests, in which the railway officials joined. Two lambs were sacrificed and their blood was smeared over the rails. This is the first trolley line in the Turkish capital, and after the people of the city learn some of the things a trolley line can do in the regular line of business, they may not be so eager to open another line with prayer; still, Mohammedans cling tenaciously to their ancient rites and ceremonies, so it would be difficult to predict whether even a modern electric car and motorman could cause them to change. How different are the customs of our own land! I have seen several trolley lines opened in different cities here. Usually the ceremony has consisted of a few short and more or less informal speeches, a quantity of cigars of a slightly higher order than those known commonly as "campaign," and several kegs of beer. The "lambs" were sacrificed and the rails smeared later in the maintenance of the regular schedule. May we express the hope that the new line in Constantinople has done all its sacrificing and smearing before it started, as part of its opening ceremony, and that its certain blessings and benefits may not be marred by some of the unpleasant things we of America endure because we fancy we must be everlastingly in a hurry.

Effect of "Safety First" Shibboleth.

"Safety first," which is rapidly becoming the shibboleth of all practical railway men, seems to be exercising a benign influence in the prevention of fatal railway accidents. An annual report recently issued by the Public Service Commission of New York State says: There was a decrease of over 72 per cent. in passengers killed on steam railroads in this State during the year ended June 30, 1914, compared with the preceding year, according to the Public Service Commission. For the same time there was a decrease of 46 per cent. in passengers injured. In the 1913 year 51 passengers were killed; last year but 14. In a statement accompanying the compilation this statement is made:

"Unfortunately, no figures are available as to the number of passengers carried within the State, these reports being made for entire rail systems within and without the State, but the fact that but fourteen persons met death of all the vast number which must have been carried during the year speaks well for the safety of railroad travel in this State."

There were 943 passengers injured during the last year as against 1,746 the year before.

Casualties among railroad employes also show a gratifying decrease, but their number is still very large; 196 employes were killed and 3,022 injured last year, as against 250 killed and 3,760 injured the previous year.

The only class of railroad fatalities which shows an increase is that of the trespasser, killed while in places where he had no right to be. A very large percentage of these fatalities were at grade crossings.

Of the trespassers, 348 were killed last year as against 393 the year before, and 358 were injured as against 409 the year before, a decrease of 14.9 per cent.

Ideas.

Who can measure the value of an idea? Starting as the bud of an acorn it becomes at last a forest of mighty oaks; or beginning as a spark it consumes the rubbish of centuries.

Ideas are as essential to progress as a hub to a wheel, for they form the center around which all things revolve. Ideas begin great enterprises, and the workers of all lands do their bidding. Ideas govern the governors, rule the rulers, and manage the managers of all nations and industries. Ideas are the motive power which turns the tireless wheels of toil. Ideas raise the plow-boy to president, and constitute the primal element of the success of men and nations. Ideas form the fire that lights the torch of progress, leading on the centuries. Ideas are the keys which open the storehouses of possibility. Ideas are the passports to the realms of great achievement. Ideas are the touch-buttons which connect the current of energy with the wheels of history. Ideas determine the bounds, break the limits, move on the goal, and waken latent capacity to successive sunrises of better days.

Drilling Hard Steel.

To drill a hard piece of steel without having clearance wear off the lip of the drill, which necessitates repeated grindings, hold the drill firmly in a vice and with a light hammer strike the face or cutting edge at the outer corners, raising a light burr. This makes the drill cut enough over size for easy clearance, and it is surprising how much wear it stands. It is much better than grinding off center, and is especially handy in drilling small dies.

Glue for Leather Belts.

Take common glue and isinglass equal parts; place them in a gluepot, cover with water, let soak 10 hours, bring to a boiling heat, add pure tannin to make to consistency of the white of an egg. Apply warm; have surfaces clean and dry; clamp joint firmly, and let dry.

General Correspondence

MR. WALTER V. TURNER, Assistant Manager Westinghouse Air Brake Compny, New York.

COMMENTS ENTHUSIASTICALLY ON OUR AIR BRAKE DEPARTMENT.

EDITOR:

I have read your article in the Air Brake Department of RAILWAY AND LOCOMOTIVE ENGINEERING for November, with a great deal of interest and appreciation.

It is such articles as this that are leading us away from the consideration of ports and passages as being the fundamental requirements in realizing the benefits of an air brake to those of principles and conditions, which, in my judgment, are the essentials, since the ports and passages, proportions, etc., are predetermined and fixed by man, while the principles which underlie the results obtained are, by means of the laws formulated from them, the basis from which these are designed and constructed, while the conditions are so many and so variable and their influence so great upon the results obtained from a brake, that a study of these and the mechanism and manipulation required to contend with them is indeed a broad and profitable study.

I do not want to be understood as belittling in the slightest degree the value of a knowledge of the air brake apparatus itself, but contend that this can be of very little value without a knowledge of the principles underlying the performance of an air brake; that is to say, the performance with regard to dissipating the energy of moving vehicles, or of the many varying conditions under which the brake operates, which obviously have a vast influence upon the result.

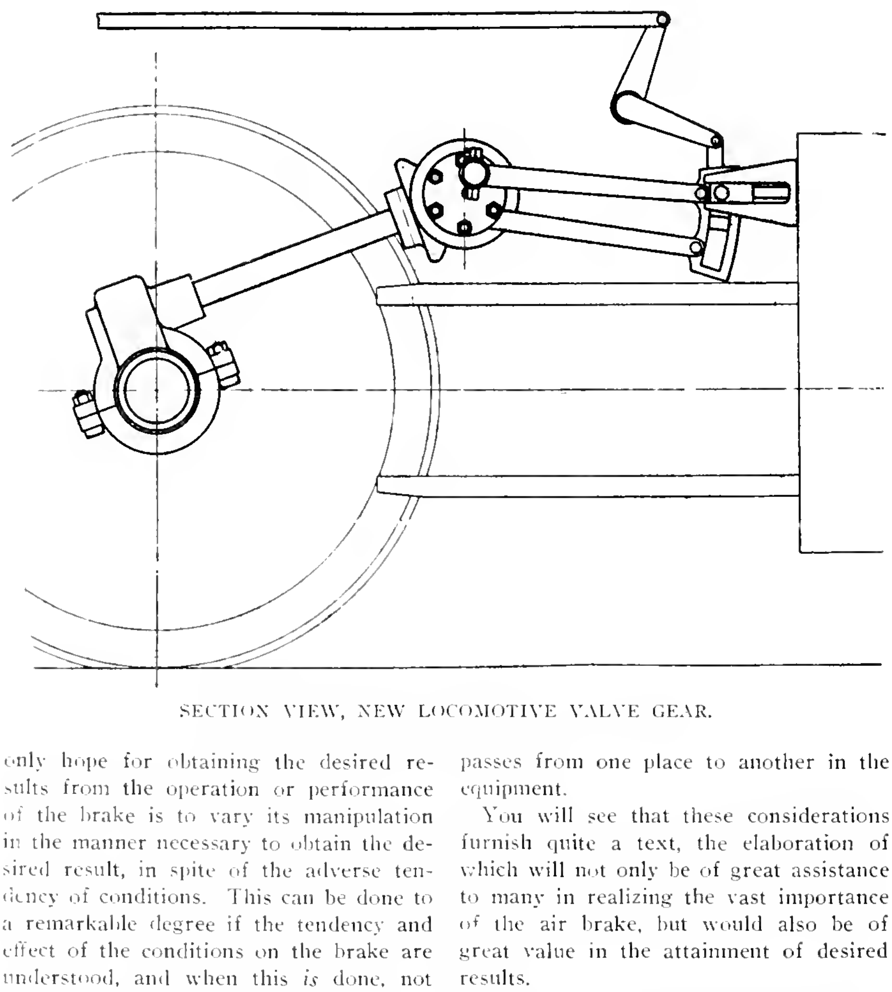
I would like to make this point to you, which, perhaps, you may some time in your future articles elaborate upon, namely, that some of the results obtained from an air brake are desired to be uniform, that is to say, in service it is desirable to control the train, to control it uniformly, smoothly, accurately and in the minimum time consistent with the realization of the other things mentioned. In emergency it is desired to control the train without shock, and to stop it in the shortest possible distance consistent with the avoidance of damaging shock. Obviously, if it were possible to provide for all these things in any design of brake, for even one condition, the brake would always perform in the same way and give the same result if there were no changes in condition. However, it is possible to design the brake only to perform in a certain way and with only a compromise with regard to performing as desired under the many conditions, but whatever this operation or operating performance of the brake may be, it is fixed; while the conditions are not fixed, and therefore, if the brake is manipulated without making due and proper allowance for the effect of the varying conditions, the result may be far from what is desired. Thus, the only hope for obtaining the desired results from the operation or performance of the brake is to vary its manipulation in the manner necessary to obtain the desired result, in spite of the adverse tendency of conditions. This can be done to a remarkable degree if the tendency and effect of the conditions on the brake are understood, and when this *is* done, not only can much loss be avoided but the earning power of rolling stock greatly increased. If I were asked to state the order in which the brake should be understood I would lay the most importance to—

(1) The principles underlying the construction of and governing the operation of the air brake;

(2) The pressure obtained in the brake cylinder or individual cars, and in different parts of the train and the time in which this takes place, for any given manipulation, measured either by the quality or the quantity of it;

(3) The effect of change in any condition of the apparatus, such as volumes, which includes change of piston travel, etc., or change in train conditions such as make up, speed or profile of road, may have on the operation of the brake, and

(4) The understanding of the construction of the apparatus, which, of course, includes the ports and passages involving the manner in which the air passes from one place to another in the equipment.



SECTION VIEW, NEW LOCOMOTIVE VALVE GEAR.

You will see that these considerations furnish quite a text, the elaboration of which will not only be of great assistance to many in realizing the vast importance of the air brake, but would also be of great value in the attainment of desired results.

Once more I thank you for the kind of articles you have been writing, particularly for that kind published in the November issue of RAILWAY AND LOCOMOTIVE ENGINEERING, and trust that you will long continue to present this means of instruction to railroad men in the admirable manner that you have done in the past.

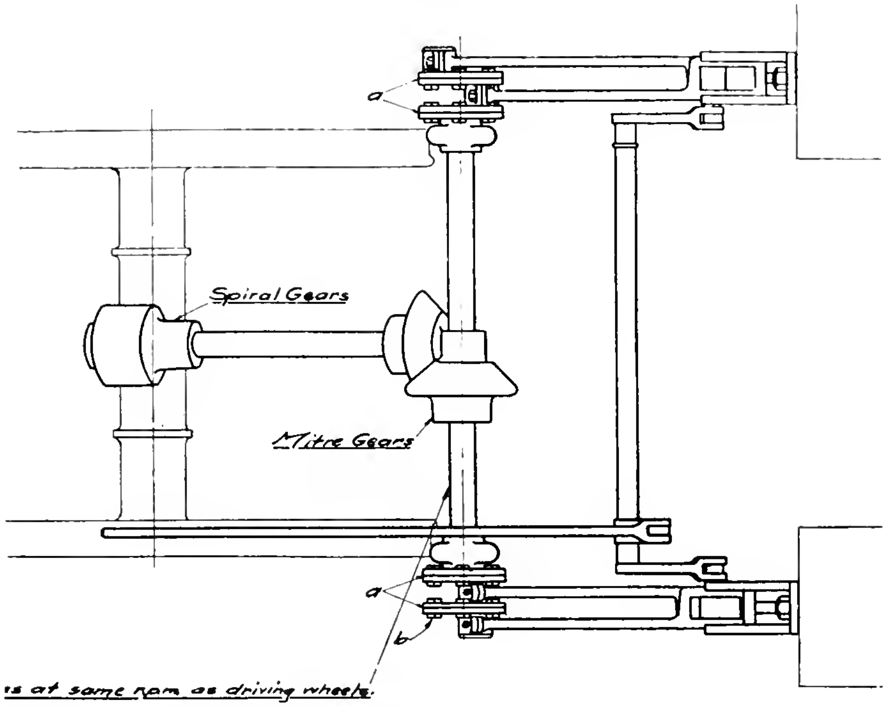
WALTER V. TURNER.
Assistant Manager Westinghouse
Air Brake Company

New Locomotive Valve Gear.

EDITOR:

Knowing you to be among the leading living authorities on the locomotive, I send you a drawing of a locomotive valve motion which I have desigend. Referring to the drawing, it will be noted that it is a shifting link motion, in what I believe to be an improved form, enabling it to be readily applied to the largest kind of locomotive. The eccentric adjustment is made by moving the discs relative to each other at the surfaces "a" before the bolts "b" are put in place. As to the use of spiral and spur gears, their use in automobiles, I am sure, demonstrates the fact that they would be as reliable as could be desired for the purpose. It has always seemed to me that the valve gearings on locomotives are too complex, and this is an effort to simplify the motion.

Minneapolis, Minn. C. W. BREWER.



PLAN VIEW OF NEW LOCOMOTIVE VALVE GEAR.

Railroad Rates.

EDITOR:

It will be remembered that the Interstate Commerce Commission in a decision of the eastern rate case stated that no showing had been made warranting a general increase in trunk line rates, and suggested to all carriers involved methods by which net income might be increased without a general rate increase. Explaining its failure to grant the increase in rates asked, though it found the railroad income to be inadequate, the commission said that the law "casts upon the carriers the burden of proof, requiring them affirmatively to show the reasonableness of increased rates" and that "the law did not confer upon us the power of aiding general prosperity or of introducing new economic policies through railroad rates." These things are true, but it is also true that the Interstate Commerce Commission possesses absolutely arbitrary power to accept an unsound and foolish argument against rate increase and to reject a logical argument in favor of it. The commission, if it is absolutely wrong in its decision, does not even have to apologize for its error. One of the first principles of law is that laws must be reasonably construed. Framers of the law did not specifically charge the Interstate Commerce Commission with promotion of general prosperity, but every citizen of the United States, man, woman or child, every public official, executive, legislative or judicial, is by all rules of common sense morally obligated to do that which lies within his power to aid and preserve the prosperity of this country The Interstate Commerce Commission has found the income of the eastern railroads to be smaller than the public interest demands. Being the only authority to which the railroads can appeal for higher compensation, why should it not grant such rates as the public interest demands?

As to methods by which the railroads may increase their net income other than by a general rate increase suggested in the decision of July, many of the railroads proceeded with all possible dispatch, doing all that brains and flesh and blood, pen and ink and printing presses could do, to take advantage of them. One large system added 30 new clerks and working nights and Sundays required over 30 days to revise and reprint its tariffs. It was found that owing to the Supreme Court decision in the "tap line" case many of the Interstate Commerce Commission's suggestions with reference to increasing revenues by charging for what it conceived to be free service wrongfully granted could not be carried out and other constituted authorities such as state laws so conflicted as to prevent railroads from getting the benefits suggested. At the very outside, it appears, considerably less than one-fifth of the relief originally prayed for, and in some instances not more than one-tenth of such relief can be got by the trunk lines from following the suggestions of the commission.

There we have the humiliating spectacle of a Federal Commission of the first magnitude living and moving and having its pernicious and paralyzing being in a cloud of ignorance, not only of the organic laws under which it blindly acts, but of Supreme Court decisions on the work in which the commission is supposed to be engaged and in regard to which it could be readily informed. While this may not be criminal in intent, it is criminal in action. The commission is worse than useless. Its suggestions are misleading. Its decisions are unjust. Its incapacity is so transparent that it is not worth while discussing methods of amending it. It should be abolished altogether. W. RICHARDSON.

Bridgeport, Conn.

Wood's Corrugated Boiler.

EDITOR:

A close reader of your paper, I perused with interest on page 403 of the November issue your article in which you so well describe the merits of Wm. H. Wood's improvements in locomotive boilers, which last have my hearty approval. You omitted to mention that in a construction like his, the permanent set, so troublesome with flat plates, is entirely done away with by the flexibility of Mr. Wood's design. Also there is no doubt about flexibility adding strength, therefore greater staybolt area can be used in accordance with the United States marine laws, and less stays are required. There you have a splendid argument in favor of this invention being used as a standard in all locomotive boilers, for it has been established as next to impossible to eradicate the trouble with stays in firebox construction as at present used.

There seems to have been a curious twist in many minds for several years past, which demanded that the bolts be given flexibility in order to overcome this permanent set, but it is a pleasure to see that at last the kink is slowly straightening itself out, and the flexibility is found to be needed in the plates themselves to

enable them, as you might say, to adjust themselves automatically to the expansion and contraction.

It is to be hoped that these few words may start the thoughts of others in a new trend, so that the true nature of Wood's improvements may be clearly perceived and wasteful and needless expenses on all railroads be prevented.

Philadelphia, Pa. J. B. Freeman.

Remedying Air Pump Failure.

Editor:

Almost all of the means and methods and new devices appearing in your Correspondence department are of much value, and shows that you are in constant correspondence with the men who are on the job. As for your other departments, especially the Air Brake Department, they are text books that are looked upon as the last word in the mechanical department of railways.

Referring to air pump failures which are liable to happen on the latest and best equipments, the following plan I think is worthy of consideration in order to prevent an engine or pump failure due to a broken inlet or discharge valve on the Westinghouse Air Brake Company's 9½-inch pump.

First dismantle type H. or K. triple valve. Remove emergency check valve from the same, and substitute same for broken valve, care being taken to place the check valve in top cage as it is too long to go in the lower cage, but as all valves are interchangeable that part is easy to overcome. With the pump in this condition you cannot tell which end of the pump is crippled.

Of course under these conditions and alterations it would be necessary to place a defect card on the car with the dismantled triple valve.

Trusting this may be of assistance to some railroad man caught in this way, as I have been, I am,

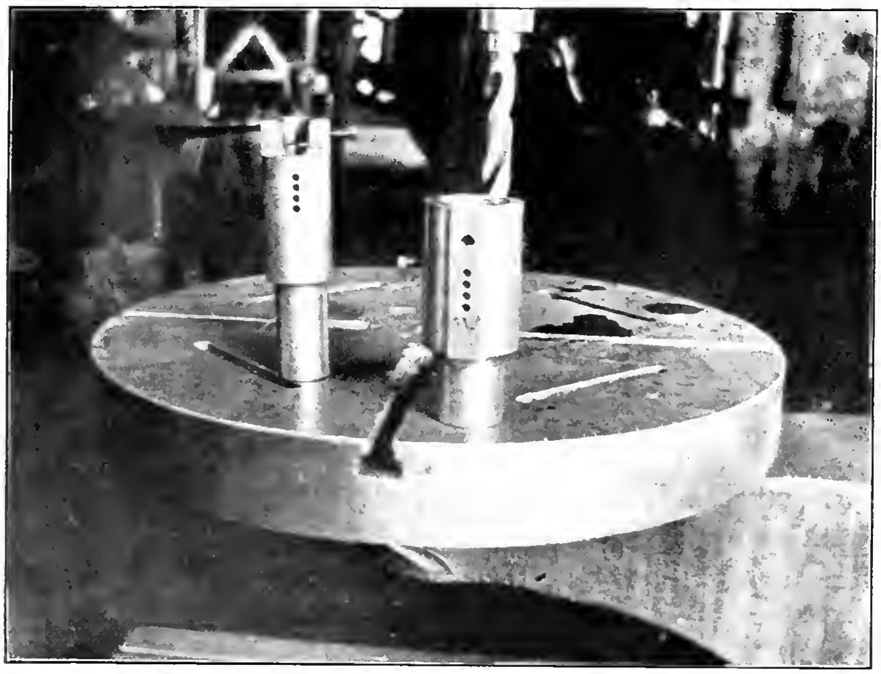
Geo. Burritt,
Louisville & Nashville R. R.

Anniston, Ala.

Lay-Out and Drilling Templets for Valve Stems and Valve Rod Stem Sockets.

By F. W. Bentley, Jr.

The laying out and drilling of valve stem and valve rod socket key slots is a piece of work on which not a little care must be exercised. Through observation of a considerable amount of this work, the writer has seen a great deal of success and excellent results obtained with the drill jig templets illustrated by the enclosed sketches and photographs.



DRILL JIG TEMPLETS FOR VALVE STEM AND VALVE ROD SOCKETS.

Fig. No. 1 is descriptive of the templet used in drilling the valve stem key slot. With the length of the stem resting on two similar V blocks, and the top of the yoke squared horizontally with the bed of the press, jig No. 1 is driven on the fit of the stem and squared by one of the flat side faces with the bed of the press also. After the set screw has been tightened, a 5/16-inch drill is run down through each hole of the templet and, of course, through the end of the stem. The jig can then be drawn back half a hole and the drill again run down through the templet to break down the bridges of the hole in the stem. It will be noticed that a portion of the forward end of the jig has been planed away. This enables the operator of the machine or drill press

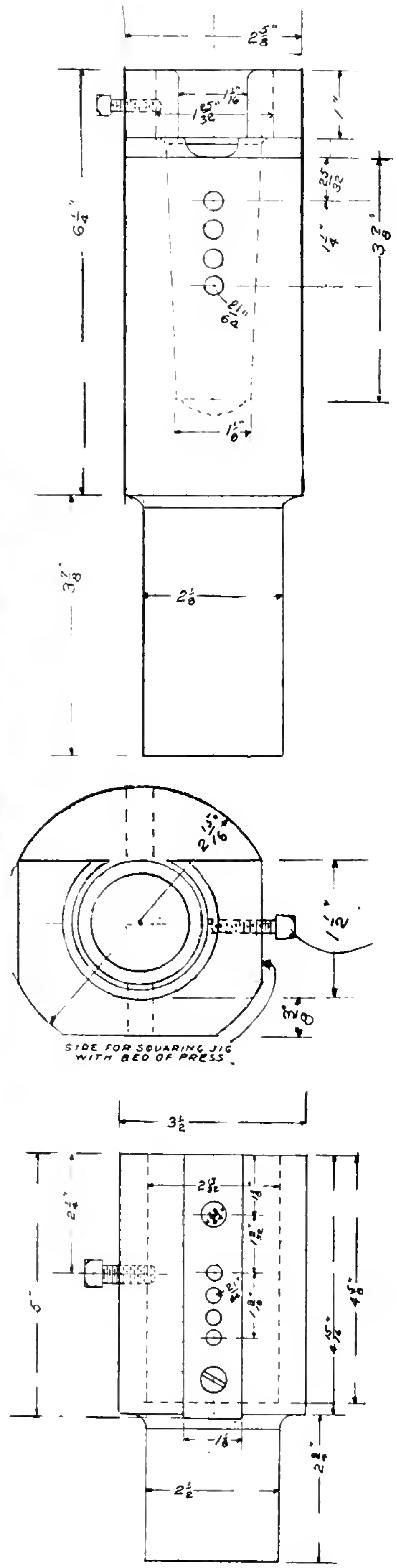
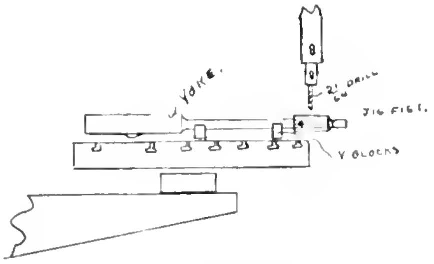


FIG. 1. DETAILS OF VALVE STEM KEY SLOT TEMPLET.



to see when the fillet of the jig is shoved or tapped up and rests against the fillet of the stem.

Fig. 2 is that of the socket templet, and

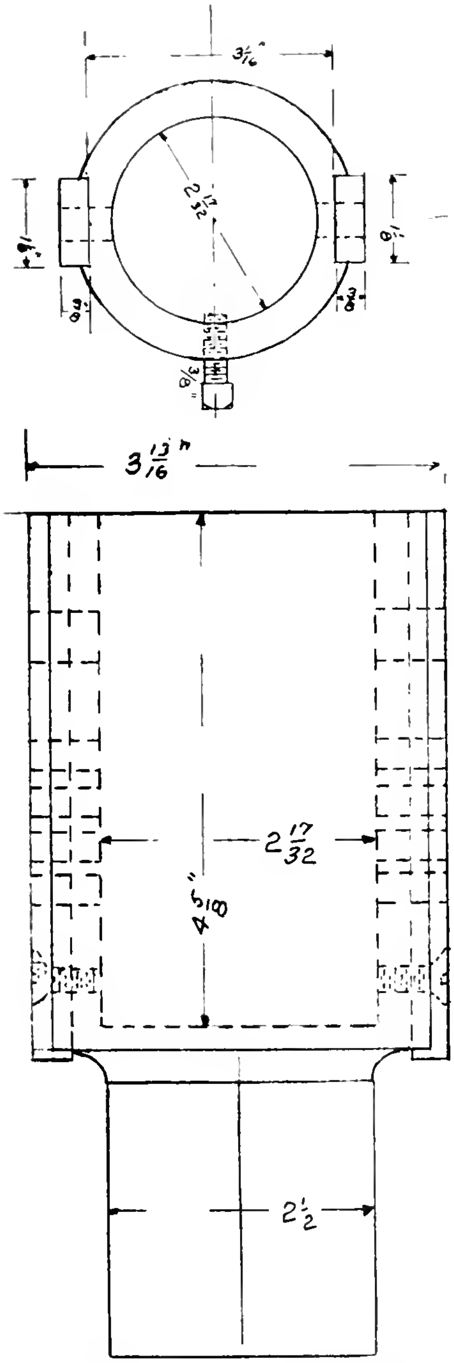


FIG. 2. DETAILS OF SOCKET TEMPLET.

when placed and tightened in this arrangement the holes are drilled for the key slot in it, and in much the same manner as those in the stem. However, as much care need not be exercised in getting it square, as the blacksmith attends to that when welding the socket end to the rest of the valve rod. If the stem hole in the socket is perfect for the fit of the stem it will be found that the slot holes in both jigs are so arranged that the 3/32-inch draw of the key has been provided for. The drift pin hole will also be at a point where the head of the stem covers only half the hole when driven into the socket. The jig can then be pulled back half a hole to drill out the bridges as same as with jig No. 1.

The devices are so simply used and applied that if the valve stems and sockets have been properly and carefully machined, any ordinary drill press hand can set the arrangements up and execute the operations of key slot drilling very rapidly and accurately, as the jigs themselves take care of the points generally worked for very studiously in the processes of laying out, but which is by the above entirely unnecessary and eliminated.

MR. C. K. FREEMAN,

Secretary of the Armspear Manufacturing Company, New York.

Comments Critically on the Development of Signals.

In the article entitled "Development of Signals," which appears in your November issue, I note the statement by Mr. Balliet that the long time burner was invented by one Dodson, of Scranton. While true that Mr. Dodson did invent certain forms of long time burners, the use of a continuously burning signal light, day and night was in effect some years previous by the Lighthouse service at locations which were difficult to reach in stormy weather, although it was always the practice to clean and examine such beacons daily when possible.

Still earlier forms of small round wick burners are to be found in old hack lamps and in the alcohol lamps, such as are used in laboratories, jewelers' shops, etc.

As to the statement in closing paragraph of Mr. Balliet's remarks that the long time burner is superior to any "flat wick arrangement known," this would depend upon the point of view inasmuch as flat wick burners will produce light of higher intensity and a broader beam through a signal lamp lens.

C. K. Freeman, *Sec'y.*,
Armspear Mfg. Company.
New York, N. Y.

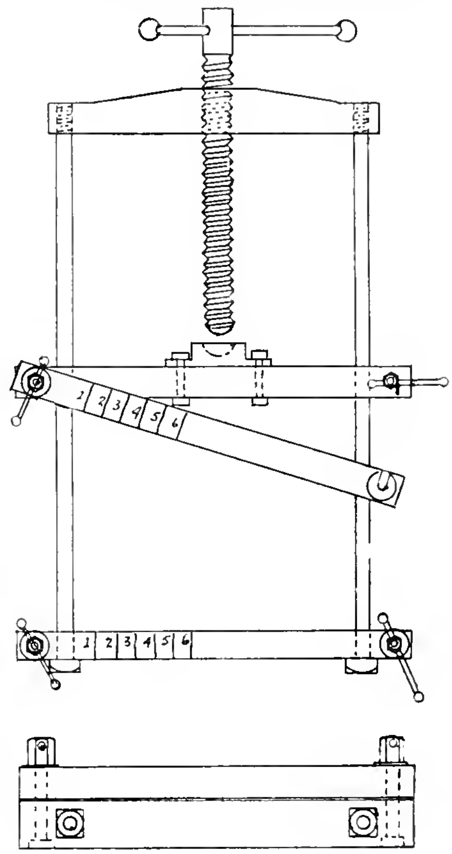
Belt Clamp.

By R. S. Booth, Hickory, N. C.

One of the most neglected parts of the mechanical appliances used in railroad repair shops is the belting. Most of the shops are equipped with a good grade of belting and after applying to the pulleys it is usually left to take care of itself until it breaks.

Enclosed is a sketch of a belt clamp that we have in use at the shops here, and we find it to be a very useful and efficient tool. When the lacing of a belt shows signs of breaking the clamp can be readily applied and the belt relaxed in place in a few minutes. As is well known, all belts slacken with a greater or lesser degree of rapidity, and it is usual to put off till tomorrow, and tomorrow never comes. Then follows disaster. With the application of this clamp the belt may be stretched to the proper degree of tautness, and relaced in position.

The drawing is self-explanatory. It will be noted that the clamp at the lower end of the drawing is rigid and when one



BELT CLAMP.

end of the belt is passed through this clamp the screws are tightened and the end securely held in place. The other clamp is readily swung out of place and the other end of the belt placed in position. An application of the long screw readily draws up the slack of the belt when the overlapping may be relaced. The scale of inches marked on the two clamps is for the purpose of keeping the two ends of the belt square to each other, which may be exactly done by noting that the two ends of the belt are parallel on the scale.

We find this clamp very handy, and also an incentive to keep belts in proper repair, as it is so easy of application at the first sign of weakening in the belt.

Importance of Coal Economy

By ANGUS SINCLAIR, D.E.

Second Article.

Combustion in Locomotive Fire-boxes.

LIGHTING THE FIRE.

Let us investigate the chemical processes that are involved in starting the fire in a locomotive firebox and in the combustion of coal when the engine is at work.

Having thrown a quantity of wood over the grates, we strike a match, with its flame ignite some greasy waste, and scattering and burning waste over the wood, set fire to the latter. The phosphorus on the end of the match combines with oxygen at a low temperature, and we rub the match to raise the phosphorus to the igniting point, by way of friction. The phosphorus flame raises the sulphur to the point at which the element combines with oxygen or burns, and the heat evolved is sufficient to set the hydrocarbon gas in the wood free, which in its turn combines with oxygen at the high temperature to which it has been raised and keeps the carbon or solid part of the match at the high temperature requisite for combustion. The flame of the match would not be sufficient to raise a large piece of firewood to the igniting temperature, because the extended surface would carry off the heat as fast as it was generated, without raising one point to the temperature of ignition; so cotton waste saturated with oil, which consists principally of volatile hydro-carbons, is employed. The waste being in a state of fine subdivision, permits the flame to communicate it to small particles which readily ignite and spread the fire through the mass. This being thrown on the wood in the firebox, lies burning on the individual pieces, and raises their temperature to the point which caused the elements of the match to burn.

A quantity of wood is needed to start the coal burning, for the same reason that greased waste was required to ignite the wood. The parts of coal are not so finely subdivided as the wood, and burning waste put upon the pieces would not raise the temperature sufficiently high to start combustion.

COMBINING PROPORTIONS.

When a compound is formed by the chemical union of two or more elements, the combination takes place according to certain definite and invariable proportions, presumably determined by the atomic weight of the elements. There is good reason to believe that each elementary substance is composed of a multitude of exceedingly minute particles of atoms. Were it possible to reach the ultimate point of subdivision, the atoms belonging to each substance would be found of equal weight. According to the atomic theory of the matter, hydrogen, which is the lightest element in nature, weighs 1 in proportion to 16 for oxygen, 12 for carbon, 56 for iron, 63 for copper, and so on. The elements always combine in these, or in multiples of these proportions to form compounds.

COMBUSTION OF HYDROGEN.

When our fire began to burn, 2 parts by weight of hydrogen belonging to the hydro-carbons being expelled from the wood or coal, combined with 16 parts by weight (1 to 8) of oxygen from the air to form water, the process evolving intense heat. The water, which goes out from the flame in the form of steam, is the only tangible product of the combustion of hydrogen, and its weight equals the combined weight of the hydrogen and oxygen that entered into union. The presence of water as a product of combustion can be perceived when a lamp is newly lighted as the steam condenses on the cold chimney, and it can be seen running in drops out of the joints round the smokebox door when a locomotive is first fired up, the cold iron having condensed the steam.

COMBUSTION OF CARBONS.

The carbon belonging to the hydrocarbon gas, and that composing the solid part of the coal, unites with the oxygen of the air to form two compounds. If there is a free and full supply of oxygen, 12 parts by weight or one atom of the carbon unites with 32 parts by weight, or two atoms of oxygen, forming carbon dioxide, usually called carbonic acid; but if the supply of air is so limited that the hot carbon cannot get hold of two atoms of oxygen, it combines with one atom, forming carbonic oxide.

When the carbon is raised to the temperature of ignition, the atoms appear to whirl around in search each of two partners of oxygen, and if the atom finds its two wives it marches through the tubes, giving out the maximum heating power. When the supply of air is so restricted that each atom cannot get two partners, they seize on one and pass onward, very weak. If the supply is not sufficient to give one oxygen partner to each of the carbon atoms, those that can get partners take them, and remainder of the atoms pass over as crude gas that gives forth no heat except what has been stolen from the gases that entered into chemical union.

In the combustion of hydrogen there is no second choice of union. If the oxygen supplied is insufficient to form the combination that produces water, part of the hydrogen unites with its full quota of oxygen and the remainder passes off unconsumed.

COAL GASES.

Coal contains small quantities of other substances besides carbon and hydrogen that produce heat, but in considering the value of fuel the engineer is interested only in the heat obtained from carbon and hydrogen. When ordinary bituminous coal is subjected to heat a rather complex array of volatile constituents are driven off in the form of gas. It is very important that the elements forming the gas should receive sufficient oxygen to satisfy their affinities and prevent them from passing away unconsumed. Among the gases to be consumed are hydrogen, carburetted hydrogen, bi-carburetted hydrogen, carbonic oxide and small quantities of other elements. The greater part of the gas is generally composed of carburetted hydrogen, and if means be taken to supply it with sufficient oxygen while maintaining the temperature above the igniting point of hydrogen, there will be very little heat wasted. But, unfortunately, the dual conditions of supplying sufficient air to the top of fire, where the volatile gases must be consumed, and maintaining an igniting temperature, are seldom complied with, and the greater part of the carburetted hydrogen passes away unconsumed. Under these circumstances the volatile gases in coal are an actual loss, for heat has to be taken from the solid carbon to gasify them. Where a road finds it as cheap to burn coke as it is to burn bituminous coal, it may be concluded that the fireboxes are so badly adapted to the burning of soft coal that the gases are wasted.

THE UNIT OF HEAT.

To estimate intelligently the value of different fuels, and for the purpose of measuring various heat operations, a thermal or heat unit has been established. The heat unit recognized by engineers and scientists of America is the amount of heat required to raise the temperature of one pound of water one degree 32 Fahrenheit.

HEAT LIBERATED IN COMBUSTION.

The operations of combustion represented by hydrogen combining with oxygen to form water, carbon combining with oxygen to form carbonic acid and to form carbonic oxide have all very different thermal values, and the unit of heat enables us to calculate them so as

to be easily understood. Carefully conducted laboratory experiments have demonstrated that one pound of gaseous hydrogen, on entering into combustion with eight pounds of oxygen, generates a quantity of heat equal to about 62,000 units. One pound of solid carbon combining with oxygen to form carbonic acid generates about 14,500 heat units. One pound of solid carbon combining with oxygen to form carbonic oxide generates about 4,500 units of heat. The difference between the heat obtained from carbonic acid and carbonic oxide, it will be observed, is very great. As careless firing is often the cause of large quantities of the gases evolved from the coal being carried through the tubes in the form of carbonic oxide, some conception of the loss entailed can easily be formed. Carbonic acid, with its 14,500 heat units, represents precisely the same quantity of coal as carbonic oxide, generating only 4,500 heat units. The only difference is in the quantity of oxygen taken up. Carbonic oxide may be formed in the burning coal for want of sufficient air, and yet be made to perform its proper share of heating if means are taken to supply it with oxygen before it enters the tubes. In that case it will take up enough oxygen to form carbonic acid.

One pound of carburetted hydrogen, when properly consumed, generates about 27,000 heat units. Oxygen combines with the hydrogen of the compound to form water, and with the gaseous carbon to form carbonic acid.

WHAT LABORATORY EXPERIMENTS TEACH.

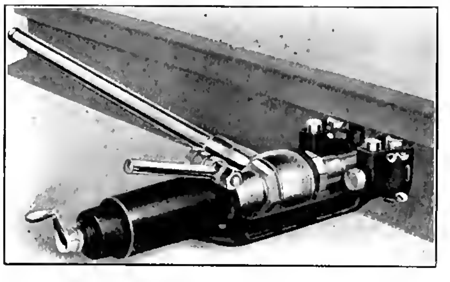
These particulars represent laboratory measurements of the total heat belonging to the various gases, and the figures are far higher than the quantity of over-utilized in furnace of firebox combustion, but they represent accurately the relative value of the different products of combustion. While the conditions under which fuel is consumed in a locomotive firebox are such that considerable waste of heat is unavoidable, an estimate acquaintance with the thermal value of the various coal products, and of the operations attending combustion, ought to guide officers in charge of locomotives to regulate the appliances controlling the consumption of coal, so that the loss of heat will be reduced to its lowest possible point.

Practical men are very ready to undervalue laboratory experiments and to class them all as fanciful theories unsuitable for ordinary work; but the master mechanics of America, who are guiding their footsteps in the light of these so misrepresented fanciful experiments, are the men who are running their locomotives at the lowest cost for fuel. The theories of combustion, as taught in scientific books, are based on facts collected by patient experimenters trained by long years of diligent labor to read nature's revelations. The wise man accepts the truths so revealed and applies their teaching to the improvement of his work.

Wedglok.

Another new and valuable addition to the mechanical appliances used on railroad work has come suddenly into favor, and bids fair to remain a favorite. It consists of a portable one-man drill with powerful automatic ratchet drilling mechanism, supported by a crucible steel frame which attaches rigidly to the ball and flange of a rail by means of a wedge-locking mechanism.

The chief merit of the device is its ready application to the rail without disturbing ballast or ties or overlapping the rail. The locking mechanism consists of four chisel points in threaded engagement with four chisel point bases, each having a 5-degree bevel at the end of the base suited to receive the point of a 5-degree bevel driving wedge: two 5-degree bevel driving wedges in a horizontal position as related to the chisel points and



WEDGLOK RATCHET RIGIDLY ATTACHED TO RAIL.

bases and suited to engage the bevel bases with the bevel end of the wedge—the other end of the driving wedge projects from the frame and is suited to be struck with a hammer. The blow of a hammer causes the wedge to advance between the beveled chisel point bases, driving the chisel points into the ball and flange of the rail. The drill is instantly and automatically centered to the web of the rail, and is absolutely rigid. The feed of the drill is automatically controlled, and is variably adjusted by a slight movement of the controlling lever. The feed is rapid until the full cut is reached, then the feed is slower until cutting through the opposite side of the rail the feed is thrown off, thus avoiding the tendency to gouge and fracture the drill.

The apparatus may be put in place and work begun in a few seconds, and may be detached almost instantly. It does not require to be removed when trains are passing on the rails where the drilling may be in progress. It may be added that the saving in drills alone soon pays for the price of the wedge-locking ratchet. In the matter of nicety of centering, a guide bearing is provided that moves forward and backward with grooved engagement with frame maintaining alignment of drilling mechanism entirely avoiding the strain of the ratchet lever on the drill. The thrust of the mechanism is carried by a pivot bearing which can be moved forward or backward by a small crank in the rear of the drill, thereby providing a quick means of adjusting the drill to its work.

It has also been observed that in the work already performed the holes are smooth and perfectly round, qualities necessary in bonding the "Wedglok" bits, being short, they are made very hard, the rigid and accurate alignment and the automatic friction feed referred to furnishing a steady automatically regulated cut, insuring the least damage to the cutting edge of the bit.

Timber in Damp Places.

The surface of all timber exposed to alternations of wetness and dryness gradually wastes away, becoming black. This is really a slow combustion, but is commonly called wet rot; the most dense and resinous woods longest resist decomposition. Density and resinousness exclude water, therefore preservatives should increase those qualities in the timber. Pitch or dead oil possesses advantages over all known substances for the protection of wood against changes of humidity. While a coating of coal-tar promotes the preservation of dry timber, nothing can more rapidly hasten decay than such a coating upon green wood.

Liquid Chalk.

A very handy thing to have on the bench where there is much work to lay out on castings or sheet-iron is a solution made of chalk, glue, and water. Take a pint can and powder enough chalk to fill it two-thirds full; then fill it almost full of clean hot water and add about two tablespoonfuls of liquid glue, and mix thoroughly while it is hot. This is much more handy than chalk, as you can put it on with a brush the same as paint. It will not rub off in handling, and gives a nice surface to work on. The chalk must be powdered very fine, or it will be rough when dry.

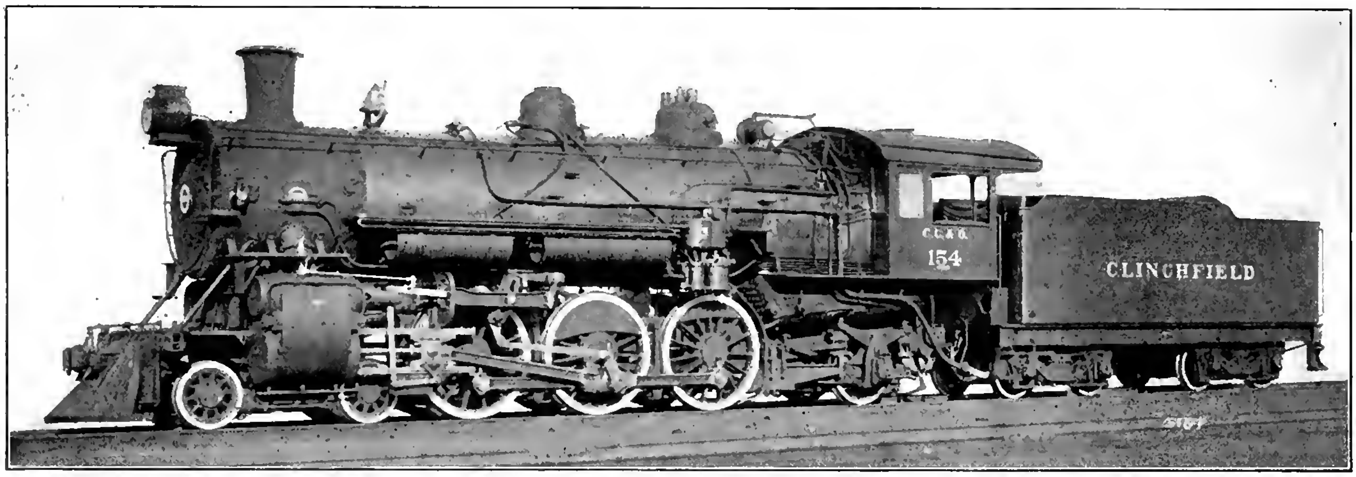
Traveling Engineers' Report.

Secretary Thompson in intimating that the Annual Report of the Traveling Engineers' Association is nearly ready, says:

"The different Committee Reports and papers were never anywhere nearly as well discussed as they were this year, and the discussion on any one of the subjects is worth more to anyone in the locomotive business than the price of the book. The Air Brake subject and the lecture on Practical Chemistry of Combustion are an education in themselves."

4-6-0 Type of Locomotive for the Carolina, Clinchfield & Ohio

The Carolina, Clinchfield & Ohio Railway traverses a mountainous country, and although the avoidance of steep grades was kept constantly in view during its construction, it is far from level. There are numerous grades averaging from 0.5 to 0.8 per cent., the maximum for a comparatively short distance being 1.7 per cent.; while one of the hardest stretches is an unbroken grade of 1.2 per cent., approximately 20 miles in length. On a line of this character, passenger service is necessarily worked at moderate speeds over the greater part of the distance; and the locomotives employed must have capacity to maintain a high draw-bar pull for sustained periods, rather than the ability to run at unusually high speeds. This requires sufficient starting tractive force, backed by ample boiler power to maintain full steam pressure when working with a relatively long cut-off at moderate speeds.



PACIFIC TYPE LOCOMOTIVE FOR THE CAROLINA, CLINCHFIELD & OHIO RAILWAY.

G. F. Shull, Act. Master Mechanic. Baldwin Locomotive Works, Builders.

These qualities are realized in two designs of Pacific type locomotives built for the road by The Baldwin Locomotive Works in 1910 and 1914, and known respectively as Classes P-1 and P-2. Three of the former and two of the latter are in service. The leading dimensions of these engines are as follows:

Class.	Cylinders.	Drivers. Diam.	Steam Pressure, Lbs.	Grate Area, Sq. Ft.	Water Heating Surface, Sq. Ft.	Super-heating Surface, Sq. Ft.	Weight on Drivers, Lbs.	Weight, Total, Lbs.	Tractive Force, Lbs.
P-1........	23" x 30"	69"	190	54	4,095	...	152,900	233,050	37,200
P-2........	25" x 30"	69"	200	53.8	3,982	955	176,900	280,300	46,000

In both these designs, the weight available for adhesion is fully utilized. This is especially true of Class P-2, which, as far as tractive force is concerned, is one of the most powerful six-coupled locomotives thus far built.

The boiler of the Class P-2 locomotive is of the extended wagon-top type, measuring 85⅞ ins. diameter at the largest course. It is designed to accommodate a 38-element superheater of the Schmidt type, and the furnace equipment includes a brick-arch, steam-grate shaker and pneumatically operated fire-door; while the design is so worked out that a Hanna stoker can be subsequently applied should such equipment be found necessary. The construction of the boiler is in accordance with the regular practice of the builders, and it presents no unusual features of design. The front end is arranged in accordance with the Master Mechanics' recommendations. It contains a single nozzle; and the stack has an internal extension, and measures 19 ins. in diameter at the choke.

The cylinders are equipped with vacuum relief valves, Sheedy by-pass valves and graphite lubricators. The cylinder and steam chest bushings are of Hunt-Spiller metal, and the bull-rings and packing rings used in the valves and pistons are of the same material. The piston heads are of the built-up type, with cast-steel bodies of dished section, to which the bull-rings are riveted. The valves have cast-iron bodies, and the bull-rings are carried on cast-steel spiders. The valve motion is of the Walschaerts type, and the valves are set with a lead of ¼ in.

This locomotive is balanced according to the Master Mechanics' rule, and careful attention has been given to the design of the reciprocating parts in order to cut out superfluous weight. The driving-tires, driving-axles, and crank pins are of chrome vanadium steel. The engine springs and frames are of steel with vanadium content and are very durable.

The main frames are 5 ins. wide, with single rail sections 12 ins. deep under the cylinder castings. The system of frame bracing has been very thoroughly worked out. The guide yoke is bolted to a steel casting which has long bearings on the upper frame rails, and extends the full depth of the leading driving pedestals. Midway between the first and second pairs of driving wheels is placed another broad casting, supporting a transverse plate to which the link and reverse shaft bearings are bolted. This casting also supports a boiler waist-sheet. A similar casting is placed between the main and rear pairs of driving wheels, and a deep brace is placed at the main driving pedestals. The rear driving pedestals are braced by a large casting, which carries the radius-bar pin for the rear engine truck. This casting also has bolted to it a vertical expansion plate which supports the front end of the mud-ring. The rear end of the mud-ring is supported in a similar manner by a plate which is bolted to the foot-plate.

The tender wheels are steel-tired, and the trucks, which are of the swing center, pedestal type, both have side bearings. The tender frame is composed of 12-in. channels, the center sills weighing 40 lbs. per foot and the side sills 25 lbs. The fuel space is closed by a chain coal-gate.

On the basis of tractive force, the Class P-2 locomotives rank with many large Consolidation and Mikado type engines employed in heavy freight service. The design has been worked out to meet specific conditions of operation, and the locomotives are unquestionably among the most notable built during the present year.

The following are the general dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.; cylinders, 25 ins. x 30 ins.; valves, piston, 15 ins. diameter.

Boiler—Type, wagon-top; diameter, 78 ins.; thickness of sheets, 3/4 in., 13/16 in. and 7/8 in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 108 1/8 ins.; width, 71 3/4 ins.; depth, front, 81 1/2 ins.; depth, back, 67 3/4 ins.; thickness of sheets, sides, 3/8 ins.; back, 5/16 in.; crown, 3/8 in.; tube, 1/2 in.

Water Space—Front, 5 ins.; sides, 4 ins.; back, 4 ins.

Tubes—Material, steel; diameter, 5 1/2 ins. and 2 1/4 ins.; thickness, 5 1/2 ins., 0.15 in.; 2 1/4 ins., 0.11 in.; number, 5 1/2 ins., 38; 2 1/4 ins., 211; length, 21 ft.

Heating surface—Firebox, 208 sq. ft.; tubes, 3,744 sq. ft.; fire-brick tubes, 30 sq. ft.; total, 3,982 sq. ft.; grate area, 53.8 sq. ft.

Driving Wheels—Diameter, outside, 69 ins.; diameter, center, 62 ins.; journals, main, 11 1/2 ins. x 13 ins.; journals, others, 11 ins. x 13 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 6 1/2 ins. x 12 ins.; diameter, back, 45 ins.; journals, 8 ins. x 14 ins.

Wheel Base—Driving, 13 ft.; rigid, 13 ft.; total engine, 34 ft. 5 ins.; total engine and tender, 66 ft. 9 3/4 ins.

Weight—On driving wheels, 176,900 lbs.; on truck, front, 52,300 lbs.; on truck, back, 51,100 lbs.; total engine, 280,300 lbs.; total engine and tender, about 435,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 36 ins.; journals, 5 1/2 ins. x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 14 tons; service, passenger.

Locomotive equipped with Schmidt superheater.

Superheating surface, 955 sq. ft.

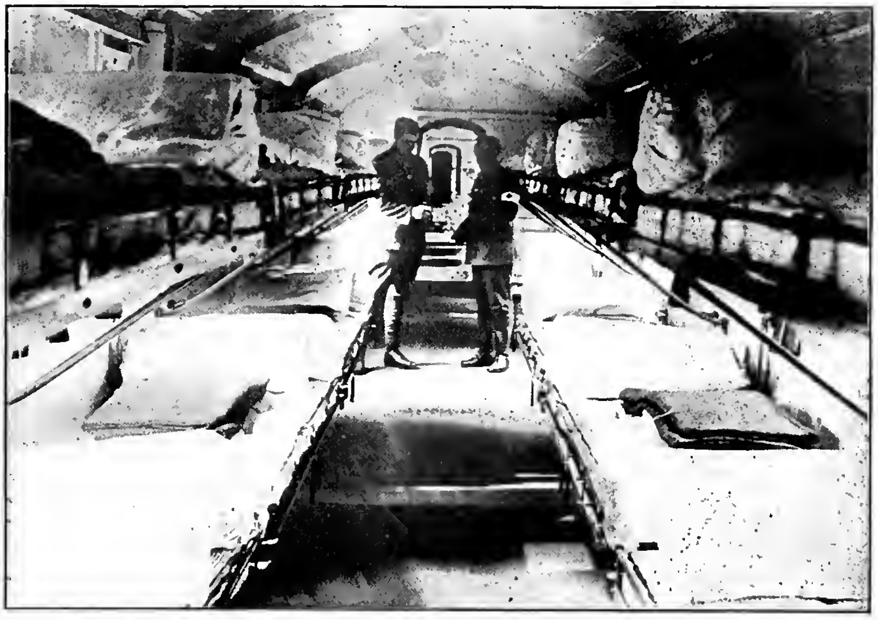
"Long" and "Short" Connection of Compound-Wound Direct-Current Motors.

Compound motors have both a series and a shunt field. The shunt field is, as with a regular shunt motor, connected across the terminals of the machine so that it is always constant with constant voltage. It may be connected, however, either inside or outside of the series field, hence the name "short" or "long." With the "short" connection the leads of the shunt field are connected as near the source of power as possible so that the voltage on the field is slightly higher and more nearly constant, and consequently the voltage regulation or speed regulation is slightly better than with the "long" connection, as the shunt field in this latter arrangement is affected by the varying drop in the series field. The design of the machine is simplified with the "short" connection as the drop in the series field does not have to be considered when determining the size of wire and number of turns of the shunt field coils.

The Ambulance Train on the Great Eastern Railway of England

For British Army Railway Ambulance Service.

To form a ward car, the whole of the compartment partitions and other internal fittings were removed, and all doors were screwed up except one pair of the double doors in that part of the vehicle formerly allotted to the guard and luggage. The result was an open car, 50 ft. by 8 ft. 9 in., ready for a surprising transformation. Substantial wooden uprights were fixed at suitable distances along the sides of the carriage, and to these the cots have been so fitted that they may be held up flush with the side of the coach and out of the way, or let down to form beds 6 ft. 6 in. by 2 ft. 6 in. The beds are disposed in two tiers and when made up are supported by stanchions to the floor in the case of the lower range and to the side pillars in that of the upper. Three sets of two on each side of the carriage, twelve in all, are provided in the larger of the two sections of the vehicle formed by the presence of the doors; there are eight more, *two* sets of two on each side, in the smaller section. In one of the cars four of the beds are specially allocated for officers. The beds, of course, extend across the carriage windows, and consequently green curtains have been fitted which can be readily drawn across whenever desirable. Beyond the beds in the larger section of the car, the lavatory accommodation has been enlarged and rearranged. The lavatory proper is on one side of the carriage, a folding wash-basin and folding table are on the other. Special arrangements of a satisfactory nature have been made for dealing with those problems of sanitation necessarily arising in a case of this kind, and a strong steam jet is provided for sterilizing purposes. Hereabouts the floor is lead covered; through the rest of the car the floor is covered with a thick linoleum. The whole interior is enameled white, and the entire effect with beds made up is most neat and reposeful.



INTERIOR OF AN INVALID WARD. COTS MADE UP READY FOR OCCUPANCY.

Education on the Pennsylvania Among the Foreigners.

On the Pennsylvania a report sets forth a statement which has been prepared to develop, among other things, what educational work might be done to improve the efficiency of the employes. For several years the railroad has conducted an educational course in English and Italian for its Italian employes. Since that course was started the question has come up: How about educational courses for employes from other foreign countries?

More than 19,000 employes of the Pennsylvania Railroad were born in those countries now engaged in the European war.

More Italians are employed than any other class of foreigners.

Thirty-eight foreign countries and the United States have supplied the men who work for this railroad.

Of the 137,525 employes east of Pittsburgh and Erie, on September 1, 1914, 33,804 were foreign born, while 103,721 were native citizens of the United States. Of course, many of the foreign born employes have since become naturalized citizens of this country.

Catechism of Railroad Operation

NEW SERIES.

Third Year's Examination.

(*Continued from page 399, Nov., 1914.*)

Q. 113.—What is a left lead engine?

A.—A left lead engine is one on which the left main pin leads the right main pin one-fourth of a turn.

Q. 114.—Are most engines right or left lead?

A.—Most engines are right lead, but the Pennsylvania R. R. has the left lead engine as a standard.

Q. 115.—How are the eccentrics kept in place on the axle?

A.—They are secured by keys and set screws, and some roads have the eccentrics fastened to each other by bolting them together.

Q. 116.—What would you do if steam chest were cracked?

A.—Disconnect oil pipe, remove the casing, slack off on all cap studs and wedge between wall of chest and studs to force the cracked sides together, tighten down on cap studs, connect up oil pipe and proceed.

Note.—Where the studs are put through the walls of chest, it will be necessary to sling a chain around the chest and wedge between the chain and walls of chest to make it tight.

Q. 117.—What would you do if steam chest were so badly broken that it could not be repaired?

A.—Remove the broken parts, disconnect the valve rod and take valve and valve yoke and rod out of the way, then drive pieces of wood into the supply ports and fit piece into top of supply ports then build up on top of supply ports with blocking, place cap of chest on blocking and tighten down on studs to hold blocking in place on face of supply ports.

If the cap of chest is broken so it cannot be used take a brake lever from a box car and put it from one stud to another across top of blocking on supply ports, and tighten down on blocking.

If the studs are gone or useless, sling a large chain around the cylinder and chest, passing it outside the guide bars at back end of cylinder and in next the frame of engine at front end of cylinder, place a heavy block on blocking to ports and use jack under chain to make the blocking solid on ports.

Q. 118.—What would you do when top rocker arm breaks?

A.—Disconnect valve rod from broken part, clamp valve with back port slightly open, remove cylinder cocks or indicator plugs and proceed.

Another way.—Disconnect broken part, clamp valve centrally on the seat, provide for lubrication and free circulation of air in cylinder and proceed.

Note.—Some people desire to have the main rod disconnected for an accident of this kind; in that case disconnect the valve rod, clamp the valve central on its seat, remove cylinder cocks, disconnect the main rod, clamp the crosshead securely at the back end of the guides when it is possible, but if the construction of the engine requires it you may have to secure the crosshead at forward end of guides, put collar on the main pin and proceed.

Note.—It is not necessary to take down the main rod, so long as you provide for proper lubrication in the cylinder, and for the free circulation of air in cylinder so that the cylinder will not heat and cut.

Note.—There are several good ways of providing for lubrication in the cylinder when the piston is left connected up to the main rod; one way is to leave the back admission port open slightly, then with the cylinder cock removed the steam will pass through port and out of cylinder cock, taking the oil, which the lubricator feeds, along with it and distributing it on the piston rod and walls of the cylinder; the steam in itself is a lubricant, and when saturated with the oil protects the cylinder for the engine to run any distance.

Another way is to pour the oil into the indicator plug openings when the valve is blocked centrally, or you may slack off on the studs to the front cylinder head, and place a small wedge of wood in between head and end of cylinder, then tighten up on the studs so the head will not loosen off and pour oil in at the opening thus afforded.

Q. 119.—What would you do if the bottom rocker arm became broken?

A.—Follow either of the above methods, being sure to make the link on the disabled side clear lower end of broken rocker arm. This may be done by lashing the rocker arm parallel with the frame of the engine, or by lashing the link hanger on the disabled side to the one on the good side of the engine, making the good link hold the disabled link away from the rocker arm, and when the link hangers are lashed together it will not be necessary to disconnect the valve rod from top rocker arm.

Another way which is absolutely safe is to take down both eccentrics and lash the disabled link to link hanger, but this takes time, and is not necessary, unless required by those in authority.

Q. 120.—What would you do if link block bolt (pin) were broken?

A.—Substitute another bolt if possible; if you have no suitable bolt, disconnect valve rod from top rocker arm, lash rocker arms parallel with the frame rail of engine, block valve with back port slightly open, remove the cylinder cocks or indicator plugs and proceed.

If it is not possible to lash the rocker arms parallel with frame and have them clear rods, either lash the link hanger on disabled side to the one on the opposite side, to hold link clear of lower end of rocker arm or take down the eccentrics and lash link to the hanger.

Q. 121.—What would you do if the bolt that attaches the valve rod to top rocker arm lost out or became broken?

A.—Substitute another bolt, or use the knuckle pin out of front draw bar and secure it in place. Do not disconnect anything.

Q. 122.—What would you do if link saddle pin (suspension stud) broke?

A.—Raise the link to the height where it will give you the desired cut-off to handle train, block between link block and top of link, remove the broken parts and proceed keeping the disabled link well oiled. Do not reverse the engine.

Note.—It is permissible and practical to place block in lower end of link, but it must be cut about one inch shorter than distance from link block to end of link to allow for the slip of the link.

Note.—When you desire to back up the longer block must be placed in top end of link to raise link high enough to place the back-up eccentric in control of the valve, and get the proper distribution of steam.

Cleaning Brass.

The United States Government uses the following mixture for cleaning brass: Common nitric acid 1, sulphuric acid ½, in stone jar, having also ready pail of fresh water and a box of sawdust. Dip articles into acid, remove to water, finally rub with sawdust. If brass is greasy, first dip into strong solution of potash and soda in warm water. This cuts the grease, so that acid has free power. Steel: Immerse for a few minutes, until all dirt and rust is taken off, in a strong solution of potassium cyanide, say, ½ ounce to wineglassful of water, take out and clean with toothbrush with some paste composed of potassium cyanide, Castile soap, whiting, and water, consistency of thick cream.

Questions Answered

Damaging a Crown Sheet.

J. D. W. Brunswick, Ga., asks: Will you kindly state how long, in your opinion, would it take the crown sheet of a boiler to be damaged with heavy fire after the water had left the sheet? A.—In a general way it may be said that the damage begins immediately after the sheet is exposed to the full force of the fire because the heat has a softening effect on the molecules of the metal and a scaling of the outer surfaces begins and the sheet will never have the same tensile resistance again. A number of experiments have been made with a view to ascertaining the length of time that it would take to cause a rupture of the boiler for lack of water, but the data is meagre and conflicting. Perhaps the most exact experiment in this direction was made a few years ago when a test was made with a view of comparing the relative resistance of a Jacobs-Shupert and a radial stayed boiler. In the former the firebox remained intact until the water had nearly all evaporated. There was some change in the curvature of sections. Three quarters of the tubes were out of the water and had sagged from the effects of the heat. Several of the tubes had completely collapsed.

In the radial stayed boiler, seventeen and three-quarters minutes after the water had fallen to the level of the crown sheet, when its level was 14½ inches below the crown sheet, the boiler failed. One half of the crown sheet came down. An examination of the boiler showed only the upper half of the tubes had been out of the water, and these had not been heated sufficiently to make them sag. The failure of the boiler was complete, as far as the firebox was concerned. There was a pocketing of a considerable section of the crown sheet. This section contained 188 crown-stays and crown-bolts. The button-headed stays failed by the breaking of the stays inside of the sheet, and the flat-headed stays pulled through the sheet. The sheet itself was not ruptured or cracked. The side sheets were in perfect condition.

It does not follow, however, that every boiler would act in this way. The writer has seen many boilers where the water had fallen below the crown sheet six or eight inches, and the result was a bulging or bagging of the crown sheet between the stay-bolts, and in some instances the sheet was forced off the ends of the stay-bolts. It would be difficult to estimate the exact length of time elapsing in such instances, but it would be safe to estimate that it would not likely be more than ten minutes. In some instances a rupture of the flue sheet occurred at about six or eight inches below the crown sheet, and the indications were that the water stood near the line of rupture.

Boilers Under Pressure.

J. M. K., Oelwein, Iowa, writes: We have had some discusion as to the alleged danger of allowing boilers to stand under high pressure. Is there more danger in a boiler standing still than there is when the engine is running, and, if so, how is it accounted for? A.—There is no conclusive proof that the danger, if any, is greater when the engine is at rest under a higher pressure of steam. Some explosions of boilers having been said to have occurred at the moment when the throttle was opened gave rise to the theory that water that has been in a boiler until the air has been expelled and then allowed to cool, can be heated to a temperature considerably above the boiling point before ebullition will take place. Water so superheated, it is claimed, will burst at once into a violent state of ebullition that amounts almost to an explosive energy, if the vessel containing it is subjected to jars or shocks. The supposition is that the boiler having been quietly standing under pressure, the water has become superheated, and then, when the throttle is opened, the outflow of steam causes a disturbance resulting in a sudden liberation of steam with a correspondingly sudden increase of pressure. If such sudden increase occurs it must act like a blow upon the sheets and may be sufficient to cause a weak section to give way and thereby produce an explosion that might not otherwise have occurred.

The Cleveland Engines.

G. E. Q., Youngstown, Ohio, writes: I would like some particulars in regard to the peculiarities of a type of locomotive known as the Cleveland engine, and which was built at Scranton, Pa., by the American Locomotive Company for the Intercolonial railway in 1901. A.—Twelve of these locomotives were constructed for the railway referred to, five passenger and seven consolidated freight engines with the Cleveland cylinders and steam chests. The consolidation engines had cylinders 65¼ inches long over all between the cylinder head joints, 21 inches bore and 28 inches stroke. There were two exhaust openings 26 inches from the steam end of the cylinder, ⅞ inch wide, 6½ inches apart, extending clear around the cylinder, and were connected direct to the exhaust tip. This exhaust tip had an annular opening outside the central one, one for the exhaust passage, and one for the exhaust passage away from the piston valve. In this design there are two pistons 5 inches thick with snap rings 1¼ inches wide so they will travel over the ⅞-inch exhaust opening without catching. The pistons are on the same rod 23 inches apart. These pistons alternately travel over the exhaust passage at the end of the stroke, so that the steam, which has followed the piston, can flash out through the annular exhaust in short order, as the piston travels 2 inches beyond this exhaust opening, the entire volume of steam has a chance to expand down before the piston starts on its return stroke and covers this annular exhaust. The piston valve also operates an exhaust passage the same as in any simple engine, closing at the right time to give the proper compression. This valve admits live steam at its inside edges which are about 44 inches apart. The boiler is straight, radial stayed, firebox on top of the frames, the firebox being 114 inches long and 41 inches wide, 73½ inches high and 28 inches from the grate to the bottom row of flues, of which there are 269, 2 inches in diameter and 14 feet in length. The firebox has 194 feet of heating surface, the flues 1,970, that is 2,264 square feet in all.

There was nothing new on this type of locomotive. It was used in 1875 on the Lake Shore & Michigan Southern railway and Ohio Central railroad. It was then called the Roberts engine. Repeated experiments have shown that its peculiarities are without merit.

Hardening High Speed Steel.

P. K., Boston, Mass., asks: What is the most approved method of hardening high speed steel? Some authorities lay down rules in regard to color, others as to particular kinds of baths or blasts. Is there any definite and reliable formula for the guidance of tool makers or tool sharpeners? A.—There are an endless variety of means and methods used in hardening tool steel, but as the different kinds of steel vary much in their peculiarities, there are no definite rules that cover all kinds of steel. The best method is to find out, if possible, the name of the manufacturers of the particular brand and ask them for information. They will all gladly furnish rules which, it is to be presumed, are based on thoroughly satisfactory experiments.

Mixed Trains.

L. M. B., Three Forks, Montana, asks: In moving a train of cars, the question has arisen as to whether it requires more tractive effort to move the train when the empty cars are next to the locomotive or when the loaded cars are nearest to the engine. What is your opinion as to the variations of draw bar pull in such cases? A.—Repeated experiments have conclusively proved that it requires more tractive effort to move the train if the loaded cars are in the rear of the train than would be required if the heavy loads were near the locomotive.

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Formation of the Standard Code of Train Rules.

Some railway organizations that are doing useful gratuitous service to railway interests are seldom heard of by the public, their innate modesty keeping their proceedings out of the press. Among the most important of these overmodest organizations is the American Railway Association which consists principally of railway officials of the higher ranks.

In the course of an address delivered by Mr. W. F. Allen at a meeting of the Railway Guild we are informed that the American Railway Association has twelve codes of rules which are standard. The first of these codes was completed in 1887 by a train rules committee of nine members. This committee which embraced some of the most prominent railway managers of that time was continued and in the course of time worked up what is now the Standard Code of Train Rules. This code has been of immense benefits to railway companies and ended the confusion that prevailed when every railway operated under what was known as its own train rules.

The Standard Code of the American Railway Association, as now used, consists of train rules for single track, adopted in 1906; train rules for double track adopted in 1906; train rules for three and four tracks; rules governing the movements of trains with the current of traffic on double track by means of block signals, adopted in 1903; and rules governing the movement of trains against the current of traffic on double track by means of block signals, adopted in 1904. To these are added diagrams of hand, blaze and lamp signals.

The Standard Code has put an end to much confusion in train operating and has prevented many accidents, but it is not so effective as it might be made. There is still positive confusion in the night lights used by different systems on stationary signals. Among these lights there is one superior to all others, and it is a very great pity that the committee cannot agree to recommend that light for general adoption.

Editorial Courtesy.

The Victoria Railways Institute Review, of Australia, after republishing the complete series of articles on "The Elements of Physical Science," which continued for nearly a year in our columns, gracefully acknowledges the source from which they copied the articles and pays a warm tribute to the ability of Mr. James Kennedy, the writer of the articles. This is just and generous, and the lesson might be learned by other editorial scissor wielders nearer home. Editorial work, like all other work, depends largely on available material and much of this work passes from hand to hand, and no acknowledgment is necessary, but when it comes to special work involving careful research, condensation and illustration, continued over a prolonged period and verified by the best authorities available, it is hardly fair that the earnest worker and the medium of presenting the work to the public should be overlooked. The whole world is welcome to any part of our pages, and we are pleased to note the reproduction in other journals of so much that we have been able to present for the instruction and edification of our readers from time to time, and while we are of opinion that the original source might be mentioned more frequently than it is, we harbor no ill-feeling against our brother craftsmen. We would rather try to cultivate the spirit of the good Samaritan who left some money at the inn to help the needy, and if that was not enough he promised to come back and give more.

Who Was Father of the Locomotive?

At a recent meeting of the Richmond Railroad Club, Mr. E. H. Walker gave an address on "Railroad Relations," in which he said:

"Who was the first steam railroad man? Will any one dispute that George Stephenson, the inventor of the steam locomotive, has the best claim to that title? Let me refresh your minds with the story:

"George Stephenson was the son of a man who fired a hoisting engine at a coal mine in England. He helped his father stoke this engine, and became interested in the operation of steam. Ambitious, he went to night school, where he received his only education. He began experimenting, and finally built a small "traveling engine" which hauled a few mining cars filled with coal, at the bottom of the coal mine. Encouraged, he built a larger "traveling engine," as they were called in those days, and on July 25, 1814, it made a successful trip between the colliery at Killingworth, England, and the port, nine miles distant, over a tramway. Stephenson ran the locomotive himself, and it was the first successful trip of a steam locomotive on any railway; therefore, he 'reads his title clear' to being the first steam railroad man.

"Now, do you think for a moment that George had an easy time. To get money for his experiments and materials, he worked at repairing clocks, mending boots, and anything else that he could find to do, and Stephenson's experience in this respect was very like that of some inventors of today. The success, however, of this first locomotive inspired others to make trials, and Stephenson built for other coal miners five engines, each of which could draw a load of 64 tons along the rails. (Compare this, if you will, with Matt Shay on the Erie, that pulled 17,912 tons the other day.) About this time the first steam railroad company was organized to run from Stockton to Darlington, England, and George built an engine which was finished and which opened up the railroad on September 27, 1825, hauling both passengers and freight, George himself driving the engine. This was the famous 'Rocket' and it was so named by Stephenson because his critics foretold its blowing up like a rocket. From here on, George's career was a success, and he was called not only to build and operate steam railroads in England as well as other countries, but to furnish motive power. This is history, and I believe proves my statement that we had a common progenitor."

We are inclined to believe that Mr. Walker's statement is a very defective history of the origin of the locomotive engine. We have studied the history of the development of the locomotive with great care and have enjoyed unusually

good opportunities for finding out the real facts which are:

Several inventors experimented with steam driven vehicles to move on common roads before 1802. In that year Richard Trevithick, a Welsh engineer, secured a patent for a high pressure steam engine. The following year he built a locomotive for railway use, which was a wonderfully crude machine, but it hauled a light train of cars and contained all the elements of a modern locomotive except the multitubular boiler. Trevithick did not feel encouraged to persist in locomotive building, but others began experimenting in that line.

An impression prevailed after Trevithick's experiments that it was impracticable to construct a locomotive that would operate on smooth rails without slipping, and several inventions were devoted to overcoming this imaginary defect. Trevithick's engine was badly over-cylindered and gave much inconvenience through slipping, which spread the impression that something other than smooth rails must be provided to give a locomotive engine hauling power.

One locomotive was built to propel itself by means of levers that acted to imitate the hind legs of a horse pushing imitation feet upon the ground. But the most ambitious of the engines produced to overcome the slipping tendency was built by Matthew Murray, of Leeds, for J. Blenkinsop, for use on the tramways connected with a colliery. The engines operated a cog wheel engaged in a rack-rail, and worked fairly well, and some of the engines were kept operating for about twenty years.

The same rackrail system was imitated by the builders of the Mount Washington Railroad in the United States, and from there was imitated by builders of mountain railways all over the world.

At the time Blenkinsop introduced the rock rail as a help to adhesion, a very enterprising and intelligent gentleman named Christopher Blackett was principal owner of the Wylam Colliery near New Castle on Tyne, and he was ambitious to use steam engines instead of horses for hauling coal. The superintendent of the colliery was William Hedley, a man of some scientific attainments, and the foreman of the blacksmith shop was Timothy Hackworth, who afterwards became a celebrated locomotive designer and builder.

Mr. Blackett had examined the Blenkinsop engines and objected to the rackrail arrangement, which he considered unnecessary. To test the necessity for using such an aid to traction, Blackett entered into a series of experiments, which proved that he had good engineering ideas. He had windlass handles attached to the axles of a car with platforms for men to stand upon. By having the men turn the wheels he found out the relation between adhesion and turning effort This indicated that a locomotive engine would have sufficient adhesion to haul cars on a smooth rail.

With the knowledge thus secured Mr. Blackett felt justified to incur the expense of building a "fire engine," as the early locomotives were called, and one was built in 1813 by Hackworth after designs furnished by Hedley. That engine was not a success, being deficient in steaming capacity, but a second one was turned out which proved perfectly satisfactory. That was the "Puffing Billy," now preserved in the South Kensington Museum, London. The engine was entirely successful and performed the work of coal hauling for many years.

When George Stephenson, who was a foreman of a colliery in the north of England, heard about Hedley's locomotive, he went and carefully examined the engine and expressed the opinion that he could build a better one, which he never did.

The "Puffing Billy" was the first of a grasshopper type of locomotive, which under a variety of modifications became used for hauling coal from the mines to the shipping points. That form of locomotive held its own until Robert Stephenson brought out the "Rocket" for the Liverpool & Manchester Railway. Much confusion exists concerning the designer and builder of that "Rocket" which was the work of Robert Stephenson, son of George. Most of the grasshopper engines transmitted the power from two vertical cylinders to a geared axle which engaged with cogs on the driving axle. The Rocket transmitted the power from the cylinders direct to the driving axle and was a simple arrangement, which appealed to the engineering world.

The Rocket was built to enter a competition of locomotives arranged for by the directors of the Liverpool & Manchester Railway, and won the first prize. It possessed all the elements of the modern locomotives and became the model for all succeeding locomotives.

It is a popular mistake to assume that George Stephenson was the father of the locomotive. He was a good representative Englishman with strong convictions that he never was backward in expressing. While others were in controversy about what was the best motive power for railways, he expressed himself very positively in favor of the locomotive, and his views induced the Liverpool & Manchester directors to adopt locomotives. When the Stockton & Darlington Railway was projected in 1824, the first line intended for general transportation, George Stephenson was appointed chief engineer and built for the road a locomotive which he called "Locomotion," which gave the name to the locomotive. In company with his son, Robert, he established locomotive building works at New Castle on Tyne. Robert was a trained engineer and he effected many improvements upon the locomotive, for which his father receives the credit.

Beginning at the Top.

It is encouraging to note that instead of discharging a number of poorly paid employees in order to reduce expenses, so as to meet the expectations of clamorous stockholders, President Fairfax Harrison, of the Southern Railway, in announcing a reduction from five per cent. to four and a half per cent. in the dividend on the company's preferred stock, says that the officers of the company have also been asked to make a sacrifice. He has reduced his own salary 20 per cent. and has asked all the other officers receiving annual salaries in excess of $2,500 to accept temporary reductions on a descending scale. A man receiving a salary of $2,700 will be reduced two per cent. The officers affected have all accepted the situation with loyal appreciation of the necessity of a spirit of mutual sacrifice. While the actual saving to the company on this account is relatively small, the principle of common interest of all those who draw their livelihood from the railway company has been the controlling motive. Many hundreds of the employees are earning less than before the depression. We have occasionally doubted the capability of men in high places to rise to the glorified heights of self-sacrifice in order that others may be exalted or even maintained, but men of Mr. Harrison's stamp bring us back to a stronger faith in the brotherhood of humanity.

A Fair Chance for the New Haven.

We cordially agree with the views expressed by a leading journal in the West that for a long time the management of the New York, New Haven & Hartford Railroad has been the target for miscellaneous abuse. Grudging admissions that the present officials were doing their best to straighten out the road's finances and improve its service have had little effect in altering the public attitude; and it suffices to speak the words "business mismanagement" for some one to cap the expression with the name of this ill-fated railroad.

This feeling of bitterness ought to stop It is a calamity for New England, for railroads throughout the country, and for the people they serve, that agitators will not let the slate be wiped clean, so as to give the New Haven a fair chance. Let the men who made trouble suffer for it if need be, but let the railroad, an enormous organization absolutely necessary to the welfare of millions of people, stand squarely on what it is doing today.

It is absolutely necessary that the public should lay aside its prejudice against this railroad, and should give its officials full credit for what they have done and are doing. Whatever price individuals may be called upon to pay for their past errors, the road itself should be allowed to face its present task with a record wiped clean.

The Steam Locomotive of Today.

The American Society of Locomotive Engineers have discussed at a recent meeting the steam locomotive of today, and it is interesting to note the views of the able committee entrusted with the subject. In the matter of progress the committee are of opinion that it has been too rapid with respect to improvements in operating facilities and progress in other features of railroad equipment. It has been rendered possible by corresponding developments of factors making for greater efficiency in boilers and engines. During the past 20 years in this country locomotive development in capacity and in efficiency, particularly during the past five years with respect to efficiency, has been remarkable and is worthy of record with progress in marine and stationary engineering.

In Europe the relatively high cost of fuel led to efforts to improve efficiency before this problem aroused serious attention in this country, but physical limitations more rigidly restricted the size and weight of locomotives in Europe. Our problem is to secure maximum efficiency combined with great size, great weight and great power which is more difficult. Since the development in the size and weight has been tremendous, even though these limits may not yet have been reached, it is appropriate to concentrate on efficiency.

Voluminous records of recent investigations of locomotive performance taken from the Pennsylvania Railroad test plant at Altoona show that the best record of dry fuel per i. h. p. hr. down to the present date is 1.8 lbs. with a large number of less than 2 lbs., while the best performance in dry steam per i. h. p. hr. is 14.6 lbs., with a large number less than 16 lbs. A reduction of 10 per cent. in fuel and 12 per cent. in water is remarkable as a result of a development of 10 years. This coal performance was recorded by a Class E 6 S Pennsylvania Railroad locomotive while running at 320 r. p. m. and developing 1,245.1 i. h. p. The same locomotive gave a fuel rate of 1.9 lbs. while running at the same speed and developing 1,750.9 i. h. p. The best water rate was given by a Class K 2 S A Pennsylvania Railroad locomotive running at 320 r. p. m. and developing 2,033.1 i. h. p. These high powers indicate that the locomotives were not coddled as to output of power in order to show high efficiencies, but that high efficiencies accompany actual conditions of operation in severe service. As to power capacity expressed in terms of evaporation, it is interesting to note that the maximum equivalent evaporation from and at 212 degs. per sq. ft. of heating surface per hour on the Altoona test plant is 23.3 lbs. These figures of high efficiency were obtained from locomotives which represented not only very careful, general and detail design, but their design included several of the improvements making for greater capacity and higher efficiency, without which the results could not have been attained.

Missouri Recalls the Full Crew Law.

A few years ago the politicians of many states came to believe that a general demand prevailed among railway train men for the enactment of laws establishing full crews on all trains. The politicians seeing a rich harvest of votes from railway men hastened in many states to pass full crew laws and most of these are now in force although entirely unnecessary, adding serious burdens to railroads already groaning under burdens their finances are not able to bear.

Full crew laws which are now on the statute books of about twenty states prescribe the number of men that shall make up a train crew and in numerous cases the men who must be employed have nothing to do. Eight similar laws have been before Congress but none has yet been enacted, although considerable pressure from mysterious sources have been urged in their favor. One of the arguments urged in favor of these laws is that the full crew tends to increase of safety of railway travel which the persons most interested declare to be absurd. The secret of the demand for a full crew is that it results in the employment of men who otherwise would be idle.

A short time ago many people in Missouri, realizing that the railroads were suffering from unnecessary burdens, determined to test the popularity of the full crew law by a referendum vote which was taken in October last and indicated that the people utterly repudiated the action of the legislature two years ago in passing the full crew law. This action of the people of Missouri appears to have given satisfaction all over the United States and we anticipate a wide spread movement to repudiate the full crew laws in all the states where they have been enacted.

The *Literary Digest*, of New York, in its issue of November 21 published a collection of opinions which reads:

"So the Full-crew Law, put on the books in response to a supposed popular demand, remarks the New York *Sun*, 'was vetoed by the public itself' in a manner that made it plain that 'the people of Missouri do not want the railroads bled.' Other papers affirm that the nation is of the same mind as Missouri. 'The people are tired of oppressive legislation against the railroads,' says the New York *Herald*, and the Brooklyn *Eagle* rejoices that 'a sense of justice seems to be asserting itself.' Missouri's decisive adverse majority of more than 60,000 marks, in the opinion of the Rochester *Post Express*, is 'the beginning of the end of meddlesome legislation having no other purpose than to burden the carrying corporations by compelling them to make worse than useless expenditures.' Missouri's verdict, remarks the Providence *Journal*, 'should encourage the Eastern roads to continue their fight against the full-crew laws which are cutting into their earnings and compelling them to take off trains and curtail plans for improvements.' The Boston *Herald* also hails the Missouri referendum result as 'one of the most significant of recent events,' and the Boston *News Bureau* characterizes it as 'a straw indicating a refreshing change in the political mind.' But if the popular attitude toward the railroads has undergone a change, the New York *World* reminds us, it is only because the attitude of the railroads toward the people has also changed for the better."

Inspection of Locomotives.

Having accompanied an old friend to the round house where he took out the engine to run a passenger train we were surprised at the expedition he displayed in taking out the engine and asked how much inspecting he devoted to the locomotive. None at all, was the reply; the man who took her in did the inspecting and besides there is a round house inspector who looks carefully over every engine as she comes in from a train. This explanation seemed satisfactory to the man most directly interested, but it is not the way that the writer managed to escape engine failures.

Our motto in engine running has always been: Do not fail to make a thorough inspection of your engine at the end of every trip. The success of next trip may depend upon the manner in which the inspection was made. Modern methods of working locomotives make it impracticable for engineers to thoroughly inspect on arrival the engines they are going to take out, but we think it would be a safe plan to examine all the leading parts before taking the engine away from the round house. Depending upon the care and vigilance of others is a practice that frequently leads to failures on the road. Not only so, but the habit of a constant and thorough inspection by the engineer himself begets a familiarity with the various parts of the locomotive that cannot be obtained at second hand, and is no trouble once the habit is established.

General Foremen's Department

Construction of the Baker Valve Gear.

The necessity that we have already referred to of providing a locomotive valve gear outside of the frames induced many clever American engineers to extended experiments with a view to make still further improvement than that already shown to be possible with the introduction of the Walschaerts valve gear. The introduction of what was known as the Baker-Pilliod valve gear was at once acknowledged as an important step in the right direction. In a few years the number 'of parts composing the mechanism have been reduced in number, thereby avoiding the tendency to lost motion, besides adding to the simplicity and stability of the structure, and in its improved form is now known as the Baker locomotive valve gear.

It will be readily observed that the device resembles the Walschaerts valve gearing in two important particulars. The eccentric crank, which gives the valve its motion, is attached to the main crank pin, and a combination lever deriving its motion from the crosshead gives the valve its position in relation to the steam ports. The most important variation between the Baker valve gearing and the Walschaerts valve gearing consists in the absence of a radial link in the Baker gear. As is well known, the link, whether sliding or oscillating on a fixed center is a source of error in all valve motions, largely on account of the slipping of the link block, and is more noticeable in the case of the shifting link as it moves through a longer extended arc than is the case when oscillating on a fixed center. This drawback has been largely overcome in stationary engine practice, but delicately automatic appliances are not suited to locomotive service.

In view of these facts it will be readily understood that if the motion of a sliding valve can be perfectly controlled and the length of valve stroke varied without the intervention of a radial link, a real gain in the economical use of steam is made.

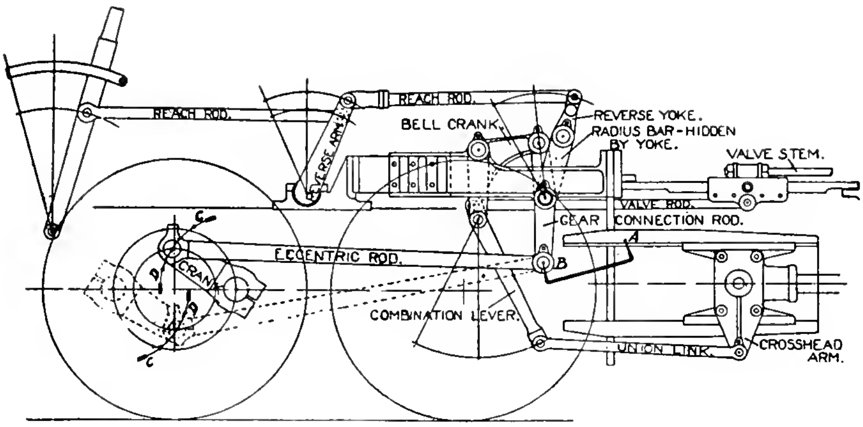


FIG. 1. THE BAKER VALVE GEAR.

Not only so, but the valve gearing in locomotive service that readily lends itself to rigidity of movement, and at the same time possesses that flexibility of adaptation essential to the various requirements of the service is all that can be looked for, and these qualities are found in an eminent degree in the Baker locomotive valve gear.

In regard to the various parts of the valve gearing it will be observed that the circular movement of the eccentric crank will impart an irregular linear movement to the eccentric rod, as also does the crosshead impart a similar varying movement to the combination lever. The crosshead travels with an increasing degree of rapidity towards the center of the stroke and diminishes in velocity towards the end of the stroke. The same remarks apply to the eccentric rod. The crosshead movement is at the swiftest point when the eccentric crank motion is at the slowest, because they are set at right angles to each other. The union link attached to the crosshead, and the eccentric rod are connected to separate ends of a bell crank. The end of the bell crank attached to the eccentric rod describes an ellipse at an irregular velocity. This varying motion is conveyed through the bell crank and the combination lever and valve rod as shown in the detailed drawings. The result of the two motions is that the valve travels very rapidly at the beginning of its stroke, and by the time that the piston has moved one-twentieth of its stroke the valve is wide open and the valve then moves very slowly during the period when the piston is moving with increasing rapidity. As the piston approaches the release point the valve again travels with increasing rapidity and closes at its highest speed.

The reversing movement is effected by the eccentric rod being attached to a reverse yoke, and when the reach rod is moved backward or forward it changes the position of the bell crank and affects the position and movement of the valve with a degree of accuracy not obtainable in any motion passing through a shifting or oscillating link. The rods and bell crank are so connected and adjusted that the placing of the reverse lever on any position affects the position of the bell crank conveying a corresponding movement on the valve rod and valve.

The number of joints in all kinds of

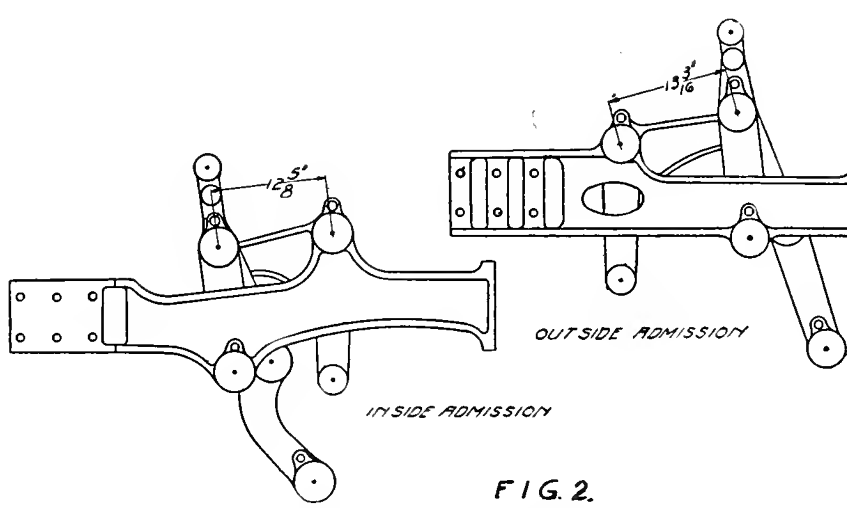


FIG. 2.

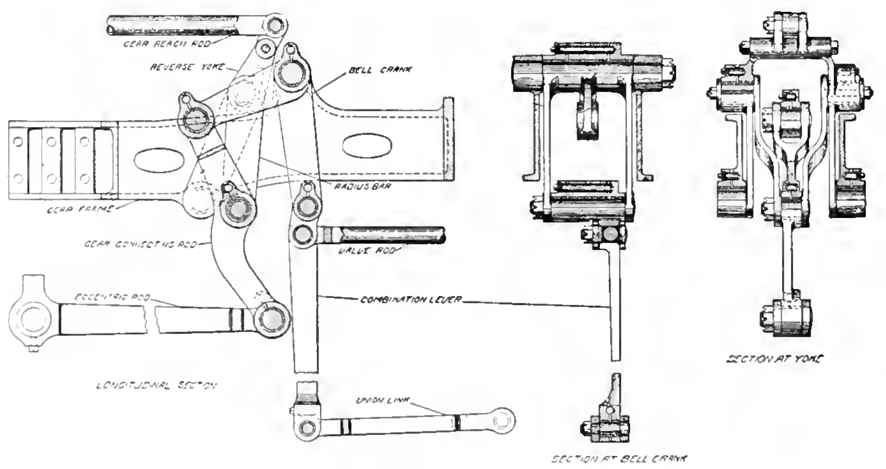
valve gearing are one of the sources of the irregularities incident to the motion. This is the chief drawback in the shifting link motion, and not only are the joints much fewer in number in the Baker valve gear, but the parts lend themselves readily to massiveness and rigidity of construction which is impossible in the case of the shifting link, and is only partially possible in the case of the Walschaerts valve gearing.

In the Baker valve gear the lead or opening at the beginning of the stroke may be rectified with ease and rapidity that is at once simple and complete. The interchangeability of the parts have proved themselves that the most advanced methods have been used in obtaining perfection in the duplication of all of the parts comprising the Baker valve gearing.

A particular advantage in running a locomotive with the Baker valve gear is the perfect ease with which the reverse lever may be moved. The lever does not act against any direct thrust of the moving parts, but the reach rod and reverse yoke acting as a lever and fulcrum moves the bell crank readily and easily.

ADJUSTING THE BAKER VALVE GEAR.

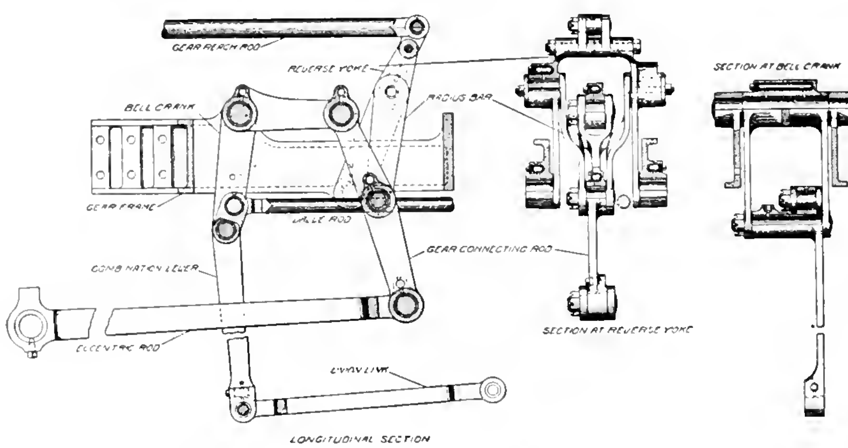
In adjusting the Baker gear all that is necessary is to connect up the gear and locate the centers in the usual way. Then check the throw of the reverse yoke, also the clearance at all points. The eccentric crank should be clamped temporarily in place on the main pin as near as possible to the specified throw. Assuming that the engine is on the front dead center, tram from the center of the pin in front end of eccentric rod to any stationary point, such as the guide yoke or guides, as shown by tram points "A" and "B," Fig. 1. (In most cases the wheel tram can be used for this work.) After scribing a line across the side of the main guide with the "A" end of the tram, revolve the wheel to the back dead center and scribe the guide again; if these two lines are together the crank setting is



DETAILS OF INSIDE ADMISSION.

correct. If they are not, knock the eccentric crank in or out until they do. The position of the reverse lever is not important while finding the eccentric positions. After the valve setter has had sufficient experience, the location of the eccentric can be determined while obtaining the dead centers.

Put the reverse lever in full forward motion position and test the full travel. If there is a difference between the right and left sides of the engine, lengthen the gear reach rod on the side of the engine where the short travel exists. After obtaining the same travel on each side of



DETAILS OF OUTSIDE ADMISSION.

the engine in this manner, the reverse lever should be put in its central position and the main reach rod adjusted until the dimensions shown on Fig. 2 are obtained for mid-gear position; then the quadrant length should be tested for the desired travel in both full forward and back motions.

The inside admission gear is direct in the forward motion and indirect in the back motion and the ratio of the gear is 4 to 1, therefore the valve will move forward 1-16 inch if the eccentric rod is lengthened ¼ inch with the lever in the extreme forward motion and the engine on dead center. If the lever is in the extreme back motion the valve will move back 1-16 inch when the rod is lengthened ¼ inch.

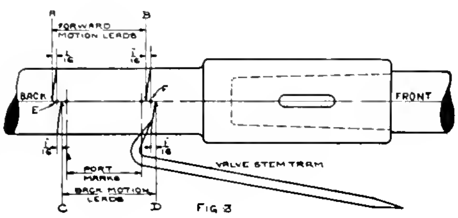


FIG 3

Having taken the port marks with your standard valve stem tram, take the lead openings in both motions as shown by Fig. 3, which shows eccentric rod ¼ inch too long for inside admission.

If you shorten the rod ¼ inch and take the lead points again the valve will be shifted back in the forward motion until lead line "A" is at "E" and lead line "B" is at "F," and in the back motion the valve will be shifted ahead until the lead line "C" will be at "E" and lead line "D" will be at "F," which will make the condition as shown by Fig. 4.

After obtaining leads as shown by Fig. 4, the length of the valve rod should be adjusted, making "G" and "H" equal. After the setter has had some experience the valve rod and eccentric rod alterations can be made after one revolution of the wheels. Referring back to the paragraph on Eccentric Crank Setting, which

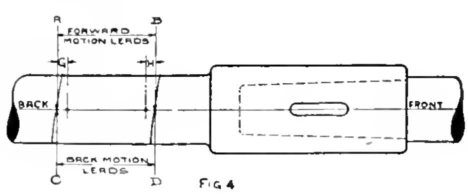


FIG 4

can be checked from the steam (see Fig. 3), on which the distance between "A" and "B" on the horizontal line of the stem is equal to "C" and "D," this will

always be the case when crank setting is correct, whether the eccentric rod shows long or short.

If the eccentric rod is 1/8 inch too short

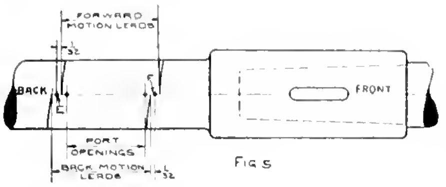


Fig 5

and the crank setting correct, the full gear lead lines will come as shown by Fig. 5:

After lengthening the rod 1/8 inch you will have the condition shown by Fig. 4.

Questions and Answers for Possible Failures of the Baker Gear.

Q.—Is the Baker gear a direct or an indirect motion?

A.—It is direct, going ahead for an inside admission and indirect backing up, and just the opposite for the outside admission type.

Q.—What are the advantages of the Baker gear over other valve gears?

A.—It is an outside gear having no links or eccentrics. The bearings are all pins and bushings, which makes it very easy to repair. It is also standard, regardless of size or class of engine.

Q.—What means are provided to keep the gear properly lubricated?

A.—All bearings are provided with a pocket or cavity cast in casting, which does away with the use of oil cups.

Q.—What parts of the Baker gear take the place of the link which is used by the Stephenson or Walschaert motion?

A.—The radius bars and reverse yoke.

Q.—What relation to the main pin is the eccentric crank set?

A.—The eccentric crank always follows the main pin.

Q.—Should the eccentric rod or eccentric crank break, how is the engine put in condition to proceed?

A.—The disabled side can have lap and lead travel and a port opening equal to the lead for all cutoffs. First block the bell crank by using a U-bolt (which should be provided) in the holes placed in the gear frame for this purpose. Throwing reverse lever in mid-gear will help to get bell crank in position to block. Second, take down broken parts. Third, knock out back pin of short reach rod and throw reverse yoke in forward motion against gear frame.

Q.—What is done should a gear connection rod break?

A.—Do the same as for a broken eccentric rod or crank.

Q.—What is done should the upper part of gear connection rod break?

A.—If break is close to the middle pin, do the same as for a broken eccentric rod and also tie lower end of gear connection rod to keep it from swinging. If break is near the top and below the jaw, first block the bell crank and wire the connection rod fast to radius bars. If break is through top jaw, do the same as for broken eccentric rod.

Q.—What is done should a radius bar break?

A.—Do the same as for broken eccentric rod.

Q.—If the horizontal arm of bell crank should break?

A.—Same as broken eccentric rod.

Q.—What is done should the vertical arm or bell crank break?

A.—Take down union link combination lever and valve rod, then block valve over ports by using set screw in valve stem crosshead provided for that purpose.

Q.—Should you break crosshead arm or union link, what would you do?

A.—If rod be provided to secure lower end of combination lever to guide yoke, remove broken parts and proceed with full train, working engine at long cutoff. Otherwise would remove broken parts, combination lever and valve rod, cover ports and proceed on one side.

Q.—What do you do if a union link should break?

A.—Same as for a broken crosshead arm.

Q.—What is done if a combination lever should break?

A.—Tie combination lever plumb same as for a broken crosshead arm, if it is possible. If not possible, take down the combination lever and valve rod and cover the ports.

Q.—What is done if a valve rod breaks?

A.—Take down the broken parts and cover ports, leaving the rest of the gear intact.

Q.—What is done if a reverse yoke breaks?

A.—If lugs for holding reach rod break, block yoke securely at whatever cutoff you wish to work the engine and take down the short reach rod. If break is below the lugs, do the same as for broken eccentric rod.

Q.—What do you do if reach rod should break?

A.—If short reach rod breaks, block the yoke at cutoff desired and wire fast so it cannot move. If main reach rod breaks, block between tumbling shaft arm and crosstie brace, wiring same securely.

Q.—What is done if the engine breaks down other than valve gear?

A.—In this case do the same as for any other valve gear.

To Keep Machinery from Rusting.

Dissolve one ounce of camphor in one pound of melted lard; take off the scum, and mix in as much fine black lead as will give it a color. Clean the machinery and smear it with the mixture.

Meeting of the Executive Committee of the International Railway General Foremen's Association.

An important meeting of the officers and members of the Executive Committee of the International Railway General Foremen's Association will be held at the Sherman Hotel, Chicago, Tuesday, December 8, 1914, at 10 a. m. As matters of great importance to the organization are to be considered, it is earnestly desired that all concerned will make an effort to be present.

The work of the association during the year is of the most interesting kind, and the various committees are already busy at work on the subjects assigned to them, and it is the determination of the officers and members of the Executive Committee that no effort will be spared to present in the best form all the facts in relation to the subjects under consideration that can be collected. With the excellent opportunities that the members have of making observations in actual practice and comparing data, valuable results may be safely expected.

Mr. William Hall, the secretary-treasurer of the association, announces that his address is now 1126 West Broadway, Winona, Minn.

Minimum Wage Law Declared Unconstitutional.

Holding the minimum wage law passed by the 1913 Minnesota Legislature to be unconstitutional, Judge Catlin, in the State District Court, handed down a decision ordering a temporary injunction against State Auditor Iverson and the members of the Minimum Wage Commission from expending further money. The ruling also suspends the order of the commission fixing a minimum wage for women and minor workers, which was to become effective today.

Judge Catlin's order makes the minimum wage law ineffective until the case has been tried on its merits. His decision will be appealed to the Supreme Court.

"The actual working of the law would be apt to increase immorality, if morals are dependent upon wages," Judge Catlin asserted in the ruling.

The law was held to be unconstitutional because it delegated the legislative power to an appointive commission and placed in that commission a discretion as to whether there should be a minimum wage. "Even the State cannot lawfully become a 'pater familias' until the form of government has been entirely changed," Judge Catlin declared.

The second constitutional ground on which the court bases the decision was the abridgment of the right of the individual to contract. The law interferes with both the employee and the employer according to the court.

Air Brake Department

Announcement.

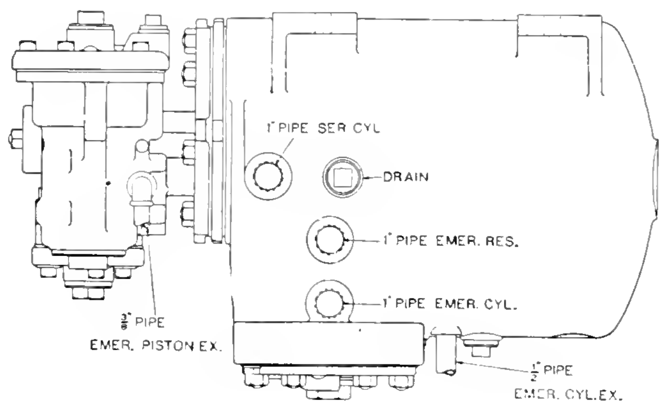
During the past year we have offered descriptions of quite a number of air brake equipments which possess improvements upon triple valve operation and the design and perfection of these have culminated in the development of the electro-pneumatic brake for steam road passenger trains, and while illustrations of the original design appeared in these columns about a year ago, it has since been improved upon to such an extent that an entirely new type of operating valve now replaces the first installation. As soon as this valve has been thoroughly tested out in service and proven satisfactory in every detail, another description will appear, but for the present the manufacturers do not encourage any publicity in connection with this brake.

P. C. Equipment.

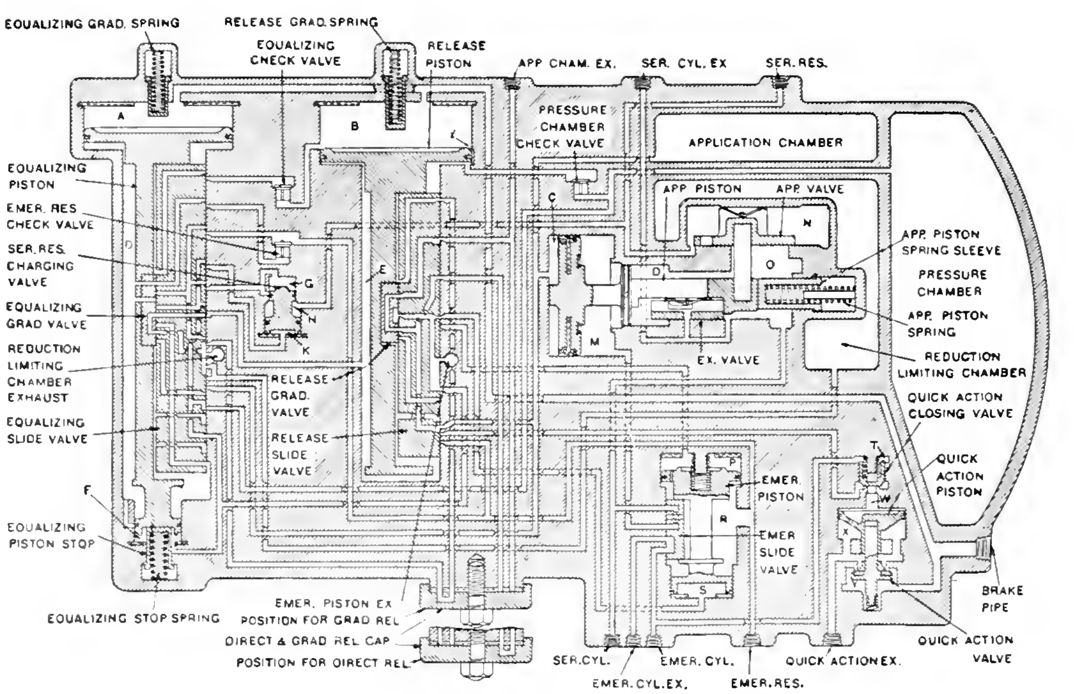
The Passenger Control equipment, designed during the Lake Shore brake tests and adopted by the New York Central Lines and used largely by the Pullman Company, was described in these columns in 1911, several issues were devoted to an explanation of the improvements over triple valve operation and an effort was made to point out the necessity for a brake of this description for heavy passenger cars.

The features of this brake are: Graduated release and quick recharge, certainty and uniformity of service operation, quick rise in brake cylinder pressure, uniformity and maintenance of service brake cylinder pressure, predetermined limiting of service braking power, automatic emergency application on depletion of brake pipe pressure, full emergency braking power at any time, a separation of service and emergency features, the employment of a low total leverage ratio, less sensitiveness to the inevitable fluctuations of brake pipe pressure, maximum rate of rise in brake pipe pressure during release, greatly increased sensitiveness to release, and the elimination of the graduated release feature.

In this brake the triple valve and auxiliary reservoir are replaced with a control valve, and two reservoirs and two brake cylinders are employed instead of one; that is, one for service and both for emergency. The control valve consists of four operating portions bolted to a control valve reservoir; the portions are called: equalizing, application, emergency and quick action. The reservoir is of three compartments, called: the pressure chamber, application chamber and re-

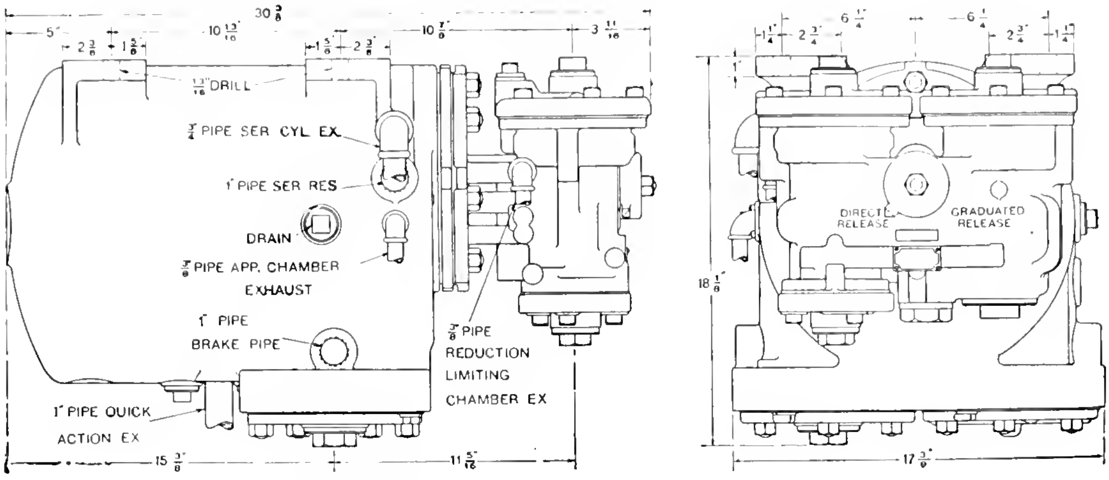


MINOR DETAILS. P. C. EQUIPMENT.



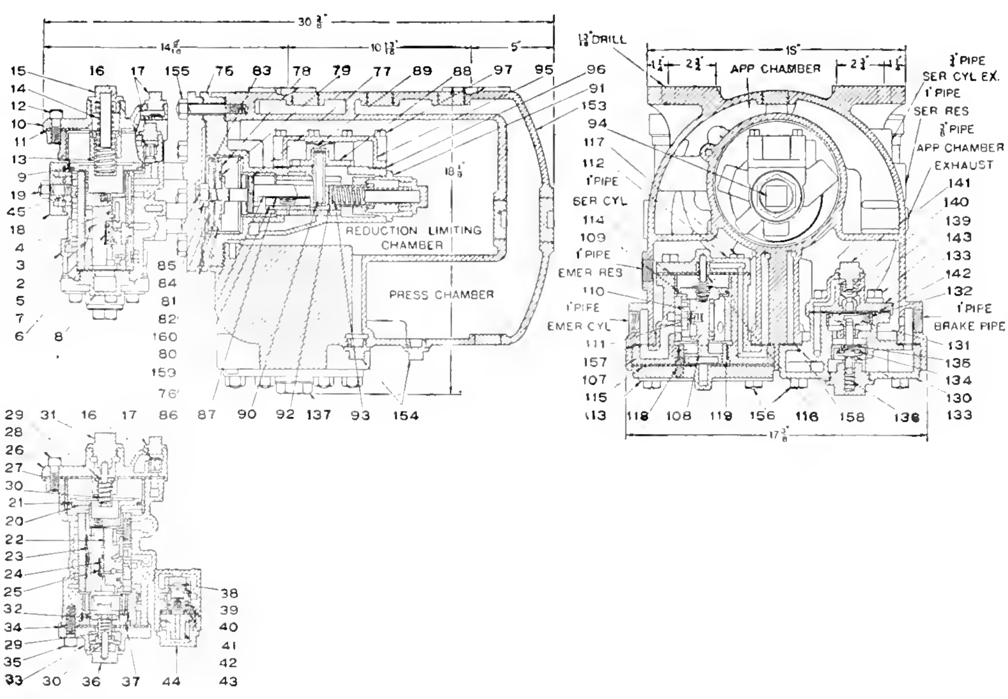
P. C. EQUIPMENT. NORMAL POSITION.

duction limiting chamber. For the reason that we have heard railroad men remark that a diagram of the valve resembles a map of the East Side and that the port holes through the gaskets must have been designed with a load of various sized buck shot, we wish to touch upon the



P. C. EQUIPMENT. OUTLINE 3-2 CONTROL VALVE.

construction of the valve without any reference to numbered valves and lettered passages, and if possible, present this in a manner that will be more readily comprehended than if all details were



ACTUAL SECTIONS. 3-E CONTROL VALVE.

dwelt upon in lengthy references to ports and passage.

The names of the various parts will be shown in the illustrations, and those of our readers who feel that they cannot handily spare the time required to trace out the various flows of compressed air during the different operations and wish to attempt a short-cut to a general understanding of this brake, should carefully note the illustrations and learn the names of the exhaust ports and pipe connections, and as well the names of the various pistons and their attached slide valves.

The outline drawing will show the pipe connections and the names, the exhaust ports and their location, while the views of actual sections will show the location of the various portions.

The view of the normal position is a diagrammatic arrangement showing all the parts assembled with no air pressure whatever in any part of the control valve.

Next month this description will begin with a diagram of the control valve in release and charging position, which we hope to explain in a manner that will be perfectly clear to anyone who understands triple valve operation.

Air Pump Heads.

There are a variety of methods of air pump repair work in vogue in the railroad repair shops, especially on top heads of the 9½ and 11-inch air pumps. Sometimes there is more than one method practiced in the same shop; in fact, practical air brake men are inclined to be guided by local conditions in this line of work. The most expensive part of the head of one pump is the main valve bushing, and in the other pump the differential valve is more expensive than the main valve bush, and price is always the first consideration in buying, but ultimate cost should be estimated with

a view of economical purchase of repair parts.

What may be termed the primitive method of repairing the top head was to force out the main valve and reversing valve bushings and discard them when badly worn, and if the top head was cracked, turn it off and shrink a band around it, and if the threads in the reversing valve chamber were stripped, the entire head was thrown on the scrap heap.

Modern methods are to rebore the piston end of the main valve bushing and purchase larger sizes of pistons and rings, or to rebore and rebush the main valve bushing to the standard size.

The reversing valve bushing is forced out, the valve guide or pin removed, and the bushing reamed or bored out and a size larger reversing valve applied.

Some shops endeavor to maintain a standard size of reversing valve bushing and go to the extent of using a brass reversing valve for the purpose of keeping the wear of the bushing to the minimum. When the threads happen to be stripped out of the valve chamber, one method of more or less merit is to re-tap it and use a size larger valve chamber cap. Another practice is to cut all of the remaining thread and a portion of the chamber away, chase another thread and screw a brass or wrought-iron bushing into the chamber, true the inside of this bushing up with the valve chamber, cut off to the proper length and thread the inside for the original valve chamber cap.

The upper steam port must, of course, be drilled through this added bushing, which can be done after it is applied by removing the brass plug at the outside end of the port and replacing it when the operation is completed. The standard reversing valve bushing is then replaced, and if the work is accurately done it is a good practice, but we have noted some very bad results where the inside of the added bushing was not in perfect line with the valve chamber.

The result of any imperfect fitting at this point is obvious, and would have the same general effect as a badly-worn valve seat in the bushing in that it would permit live steam to flow to the upper end of the valve rod through the cap nut.

In several instances that we know of such work has passed the air pump test in the shop, but would show up under a high steam pressure. If this character of repair work is attempted it should be done in accord with a blue print which will outline the method and specify the length and diameter of the added bushing. This cannot be attempted in the small repair plants where all machines are crowded to their capacity because no wide-awake foreman would consent to delay his machine work and hold up an engine in order to save a few dollars that would be spent in buying a new head

As to the main valve bushing, if the repair work is to be reliable it is essential that the main valve cylinder head and the cylinder part of the bushing be kept reasonably true, regardless as to how it is done. The main valve pistons must be at least a fair fit in their respective cylinders, and the piston rings must not be loose, either in the cylinders or in the piston grooves. Reboring and bushing the main valve bushing and the left main valve cylinder head is not practiced to any great extent principally because when the main valve pistons are worn in the grooves and somewhat smaller than the cylinders they are no longer fit for use, and in the 9½-inch pump the differential piston costs more than the main valve bushing; then buying a larger size of pistons only requires the truing up of the cylinders and at the same time permits of maintaining a standard thickness of piston ring, which is very desirable, as some awful air pump repair work is done when filing packing rings along the sides becomes a practice, or necessary to get them to enter the piston grooves, especially so when it is done on the rings in the air cylinder. When engines run into a large repair shop, reboring and using larger pistons is an excellent practice, even if it does necessitate the carrying of different sized packing rings in stock; but it is a questionable practice if the air pumps are to be repaired at various small stations, especially if trained air brake men are not employed.

Fortunately in air brake work, one loss frequently offsets another, and if the badly-worn bushings and cylinder heads are thrown away or used in pumps in some other class of service, the replacing of new parts will maintain a standard size that will be equal to saving many dollars in shipment of repair parts to points along the line of road.

A short time ago some suggestions relative to the maintenance of the air cylinder were made, and recently a method of fitting a steel bushing into an air valve cage has been brought to our notice. The worn valve cage is bored out on the inside and threaded, and a bushing is screwed into it and turned off to form a new seat which can reasonably be expected to give as good results as the use of a new cage, and if the bushing is left a trifle full in length and a trifle smaller in the inside diameter, many badly-worn air valves can be used instead of being thrown in the scrap, as is the usual method.

The reversing valve bushing of the 11-inch pump can be forced out and have the flat seat trued up and a new valve applied, and this should be done whenever the pump is in the air room if the valve seat shows any wear, as the heavier valve rod of this pump is more liable to pull the reversing valve out of place when the piston is making the down stroke if there is considerable leakage on the reversing valve seat. The reversing or short stroke generally follows the pouring of oil into the steam end of the pump, which practically destroys the friction between the valve and seat or the resistance to the movement of the reversing valve. The result is what is slangily termed the "jiggling" of the pump.

Another trouble peculiar to the large pump is that when the packing rings in the air cylinder become loose or pretty well worn, the pump sometimes goes lame for a few strokes, the air sometimes gets between the outside of the rings and the cylinder, and the action of the pump has the appearance of a broken discharge valve. It usually occurs on the down-stroke and after the pump has received a few cups of oil, that is, when about one-half of the cylinder is lubricated and the other half is dry.

Of course, the proper repairs are to remove the pump and renew the piston rings, and in the other case force out the reversing valve bushing and true up the seat; but the writer must admit that he has been placed in positions where in order to get a pump started, he was compelled to coat the reversing valve seat with flour of emery, and in order to get pumps to receive air on both strokes was compelled to pour a pint of valve oil into the air strainer.

The larger railroad systems and many of the smaller ones, make an effort to have the air pumps removed from the locomotives at stated intervals for repairs or rather for inspection, and repairs, if necessary; but in spite of this there is still some freakish repair work done on air pumps on the locomotive. One particular case we have in mind, is where a broken discharge valve was found in an 11-inch pump, and a piece of it had worked back into the air cylinder and prevented the pump from reversing at the upper end of its stroke.

The repairer evidently knew what was wrong, but was not disposed to remove the pump from the locomotive or to draw the air piston and remove the piece of broken valve; instead, he removed the reversing valve rod, made an iron ring about ⅜-inch thick and just large enough to encircle the rod, then split it and forced it on the rod between the shoulder and the button to form an extension for the shoulder on the rod.

In this manner the reversing plate touched the shoulder through the medium of the ring before the air piston was stopped by the piece of broken air valve, and the pump continued to run regardless as to its state of efficiency.

Entirely too many air brake repairmen pride themselves upon their resourcefulness in cases of emergency, and imagine that their competency is rated by the shortest possible space of time in which they can accomplish a certain op-

eration, but their efficiency is frequently at an inverse ratio to the time consumed in making certain classes of repairs.

We know of incidents in which an air pump failed four times within a week, the first time on account of defective air piston packing rings, the second time on account of a loose air piston, the third time because of a broken air valve, and the fourth time the air piston was broken off of the rod, each failure traceable to, and the natural sequence of the character of the repair work that preceded the failures.

Vocational Training.

According to the investigations made by the Commission on National Aid to Vocational Education, there are fewer trade schools than exist in the now unfortunate little German kingdom of Bavaria, with a population but little greater than that of New York City. Until the outbreak of the European war more workers were being trained at public expense in the city of Munich that in all the larger cities of the United States put together. In a democratic country the education of its citizens is one of the most important functions of the state. A worker who is not trained to work is not educated. Neither is he educated if he is trained only to work. The state alone can give him the broadest training possible in the given time and without sacrificing the training for his job, is the belief of the National Society for the Promotion of Industrial Education.

"This increased demand for trained workers makes an irresistible appeal for vocational training. The European war and its disastrous results will be certain to emphasize this situation," says C. A. Prosser, secretary of the National Society for the Promotion of Industrial Education, which is to hold its eighth annual convention in the city of Richmond, Va., December 9 to 12, 1914.

This national society with the long name has been the leader in this country in the movement for industrial education. In the belief that the society must work in the most practical manner possible in aiding the country to meet these demands which the war will make upon us, it has planned a convention unique in the history of such gatherings.

According to William C. Redfield, Secretary of Commerce, who is also president of the National Society for the Promotion of Industrial Education, the danger of poor industrial education is a serious one, not only to worker and manufacturer, but to every citizen. Our national prosperity depends largely on the right solution of this question.

In this regard we may be privileged to state that the men employed in the mechanical department of railways are, perhaps, in the very fore front of the industrial classes who, without any state aid whatever, have found time and means to educate themselves to a degree of excellence that is at once an example to others and a credit to themselves, and the continued encouragement that comes to us is a proof that our work in this cause has been appreciated.

Scarcity of Subjects for Discussion.

The secretaries of the various railway clubs seem to be falling short of subjects suitable for discussion and subjects are now frequently introduced that few railroad members are interested in. The fact that these clubs have been discussing for many years the subjects most prominent in railroad business lines naturally exhausts the themes that would excite discussion, but we think that it would be well for the officials of such clubs to bring up again subjects that they may consider old and threadbare. There is a constant change going on in the personnel of all the railway clubs and the younger members are entitled to have light thrown upon subjects that have been exhaustively discussed in past years. This need does not apply to new and young members exclusively, for many of the older members would receive benefit from refreshing the memory concerning subjects discussed years ago. Subjects that were of vital interest twenty years ago are worth going over again in this year of grace.

Turning Fireboxes Into Projectiles.

The fact that on nearly all European railways the fireboxes of the locomotives are made of copper is figuring curiously in the war now raging. Copper figures largely in the manufacture of projectiles and no other metal is of any value for that purpose. A recent report says that copper is becoming so scarce in Germany that orders have been given to dismantle as many locomotives as possible on the State railways in order to use the copper for making projectiles.

More About the People's Railroad.

In our October number appeared an article reflecting upon a no profit railroad scheme in operation at Fairhope, Ala., the information being gleaned from a local paper. We have recently received from Mr. E. B. Gaston, president of the Fairhope Railroad Company, a letter defending the scheme and saying that it is a legitimate business enterprise. Among other things Mr. Gaston writes:

"The railroad company is an entirely independent organization, duly incorporated, but under a statute providing for certain corporations "not for pecuniary profit." It has no stock, but is controlled by those interested enough to pay a membership fee of $5 and enroll themselves as members. The members control the road by election of its directors, 15 in number, but receive no profits in any way from its management over others who are not members.

Reliance for funds for the building of the road is upon sale of bonds, of which there is an authorized issue of $150,000, bearing interest at 6 per cent. and payable in 1933. These bonds are secured by trust deed upon the entire property of the company, the same as the bonds of any other honestly managed railroad company.

There is no idea on the part of anyone to "secure railroad accommodation for nothing." But that it shall not cost the people who are to furnish it its business any more than legitimate operating and maintenance cost, with interest and principal upon its bonds.

There is no question but that this is a very novel idea in railroading, its novelty arising from the fact that those responsible for the idea approached the subject from the standpoint of those needing the service, instead of from the standpoint of promoters merely; but novel though it may be, I see no warrant for calling it "silly" and think you owe us an apology for this offensive epithet."

Electric Motors for Steering Large Ships.

The device consists of two 150-horsepower, 120-volt, d. c. motors which can operate singly or together. The apparatus is fitted with clutches so that an auxiliary steam set can be used in case of emergency. The motors can pull the rudder from "hard over" to "hard over" in approximately 20 seconds when the vessel is moving at full speed. The motors are fitted with electric brakes. An automatic device is fitted to the motors so that when the rudder is turned through 35 deg. it is stopped by the electric energy being cut off. This prevents the rudder being turned too far and causing damage.

Removal.

The Power Special Company, whose main offices are at 111 Broadway, New York, having found it necessary to secure more commodious quarters to properly handle the growing business in the central district, have secured more extensive quarters for the Chicago office, and has removed from the Peoples Gas Building to the Harris Trust Building.

Progress very satisfactory to the Chattanooga Chamber of Commerce in its activity for better train service to New York and the East was made at a conference at Chattanooga, between officers and others interested, and officials of several railroads. The citizens were assured that as soon as business conditions warrant it, the train known as the Birmingham Special will be operated to and through Chattanooga direct, instead of through Atlanta.

Electrical Department

The Production of Artificial Daylight.

Those who are dependent upon artificial light will welcome any move toward the improvement of this light and especially toward artificial daylight.

With the introduction of the gas filled tungsten light, it is possible to get some very good daylight effects, and M. Luckiesh has carried out many experiments along this line. If the filament of the tungsten light could be heated up to 5,000 degs. C., the quality of light would closely resemble noon sunlight. As it is not possible to do this, some practical means must be used, and it has been found that the light can be obtained by passing it through a colored screen.

In producing artificial daylight it is quite desirable for the light source to have a continuous spectrum. The tungsten lamp is well adapted for this work and the problem is to obtain colored glass of such character that the transmitted light contains the various colored rays in the same proportion as the daylight. A number of coloring elements are found to be necessary in order to produce a glass which fulfills the requirements.

It is necessary to obtain standards of daylight, and three were finally chosen, these three each requiring its own glassware.

The first when used with the high-efficiency tungsten lamp should reproduce north skylight; that is, the light from an average north sky. This would find its use in arts requiring accurate discrimination of colors.

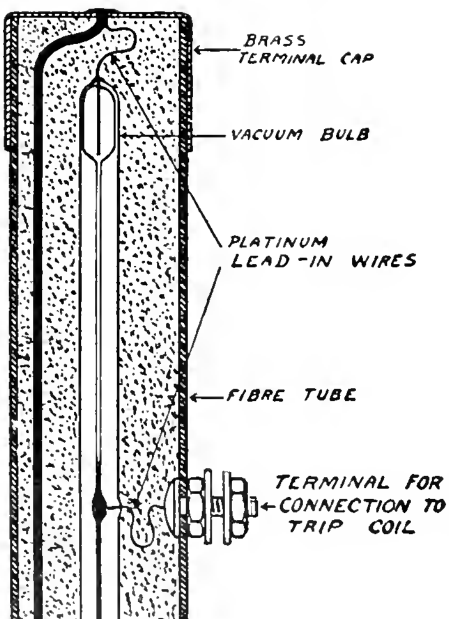
The second class was designed to reproduce clear noon sunlight. This could be taken as an average daylight because it represents approximately the mean of all phases of daylight out of doors during ordinary daylight working hours. This unit would find a field in the general lighting of industrial plants, such as those engaged in lithographing, color printing, manufacture of paints and wall-papers; also in paper mills, paint shops, cigar factories, art galleries, etc.

A third class was considered as a compromise between daylight and ordinary artificial light. From another viewpoint this class might be considered as a compromise between wattage and quality of light. With these three classes in mind the problem of obtaining colored glass was attacked.

The gas filled tungsten lamp is of such high power per watt that, even though the glass screens do cut out a certain per cent. of the light, enough passes through to make the whole of high efficiency so that artificial noon sunlight can now be produced at an efficiency not far from the old tungsten lights.

A Thermo-Relay.

At times it is very desirable to have some means of regulating the temperature either of an electric machine which may be subjected to heavy loads or of spaces or baths which are heated by electricity. A thermo-relay, manufactured by the



DETAILS OF THE THERMAL RELAY.

Bruch Electric Controller Corporation, of Oakland, Cal., embodies the use of a mercury thermometer. This thermometer is surrounded by an insulation and the temperature-time characteristic may be varied by changing this insulation. The bulb of the thermometer is surrounded by a heating element in series with the live wire so that the heat at the bulb depends on the amount of current being taken. The thermostat is provided with a contact portway up the tube, so that when the mercury reaches this height current passes to the trip coil of a circuit breaker and the main power circuit is opened.

A Novel Method of Coupling Cars.

We have all heard of various methods for coupling the cars to a locomotive, but it is a new one to us all to know that it is being done by electricity.

The Swiss federal railways have built a small storage battery electric locomotive which is used for switching cars. This locomotive is equipped with the same type of battery as is used for car lighting. In switching service, the locomotive is brought up to the car until the buffers touch. The engineer then turns the current through a large coil of wire which energizes the buffer of the locomotive magnetically and the buffer of the car is held by the large magnet. It is possible to pull many hundred pounds by this attraction. Time and expense are saved by this arrangement.

There is nothing particularly new in this arrangement except the application of this principle to railroad work, as for the past few years we have had the magnetic crane; the crane consisting of a large piece of iron or steel which is magnetized and which is used to pick up pieces of iron, the iron clinging to the magnet until the electric circuit is broken. These electric cranes are of great use where scrap iron is handled, as many hundred pounds can be lifted at one time regardless of shape and size of the pieces.

Electricity Used for Sterilizing Milk.

The usual procedure of milk sterilization is to heat the milk, but this method has been criticized by eminent physicians, as when the milk is heated above a certain temperature of approximately 150 degrees, many of the bacteria which are not harmful are destroyed, and the dangerous germs are not destroyed, but developed by the heat.

Experiments have been made, using electricity, and the results were so successful that this method has been carried out on a large scale at Liverpool, England, for several months.' It was found that electricity reduced the germs to a minimum while not destroying the properties of the milk.

The apparatus consists of glass tubing about ¾-inch in diameter in which are placed three electrode chambers, these

chambers spaced about 25 to 30 feet apart. The milk is passed through the glass tubing and through these chambers. In each chamber is placed a long copper rod which is connected to the circuit of a high voltage transformer. The scheme is to connect one terminal of the transformer to the rod in the centre chamber and the other terminal to each of the two outside chambers, so that the electric current will pass through the milk, flowing through the tubes, between the centre chamber and each of the outside chambers.

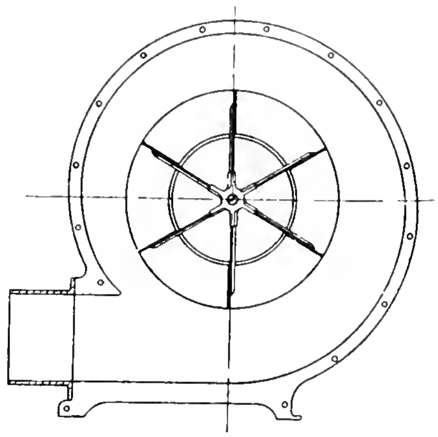


FIG. 1. DIAGRAMMATIC SECTION OF AN ORDINARY FAN BLOWER.

Electrically Driven Air Compressors for Foundry Use.

There are now in service four distinct types of air compressors classified as follows.

First—The fan blower used where large volumes of air are required at low pressures from ½ lb. per sq. in. up to 1 lb. Since it has low efficiency it should only be used for very low pressures. Fig. 1.

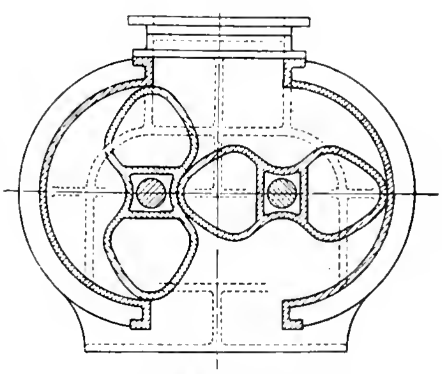


FIG. 2. DIAGRAMMATIC SECTION OF ONE TYPE OF POSITIVE PRESSURE BLOWER.

Second—The positive pressure blower from 1 to 10 lb. Fig. 2.

Third—The piston type compressor adapted for high pressures from 30 lb. upwards.

Fourth—The centrifugal compressor which is designed for any volume and pressure for which either the piston type or positive types have been used, from volumes of 500 to 50,000 cu. ft. per min. and at pressures from ¼ lb. per sq. in. upwards. Fig. 3.

In the fan blower the impeller revolves at a comparatively slow speed and the low pressure, usually about ½ lb., is produced almost entirely by centrifugal force.

The principle of the positive pressure blower is different. This type consists of one or more drums with lobes which pocket the air and convey it to the outlet. The delivery of air to the discharge is intermittent usually between one hundred and two hundred per minute and thus the air pressures fluctuate, which does not make this type as well adapted for foundry work.

The General Electric Company first took up the design of the centrifugal compressor. This type of compressor consists of one or more rotating impellers supported on a shaft and surrounded by a stationcry set of discharge vanes, the whole enclosed in a casing.

When the impeller shown in Fig. 3 is made to revolve, it will entrain by centrifugal force a fluid, such as air, at its inner periphery and discharge it at its outer periphery. At this latter point the air contains by reason of its centrifugal pressure and its velocity, two forms of energy, potential and kinetic. The function of the discharge vanes is to convert the velocity energy into pressure energy. These discharge vanes, Fig. 9, are designed in such a manner as to gradually reduce the speed of the air as it passes through them and thus recover the velocity energy in the form of an increased pressure. The air is thus delivered at a perfectly steady pressure, producing a steady pressure in the foundry cupola giving uniform melting.

Considering all four types the following conclusions may be drawn:

First, the principal difficulty with the fan blower when compressing air to sufficient pressure for cupola blowing is that its efficiency is lower than that of other types.

Second, the positive type of blower does not maintain its efficiency without excessive maintenance cost. It creates a fluctuating pressure which produces unsteady conditions in the cupola and results in irregular melting of the iron.

Third, the reciprocating compressor, although better adapted to higher pressures, is not applicable to cupola blowing.

Fourth, the centrifugal compressor has a high efficiency; maintains this efficiency; requires very little attention; the cost of maintenance is extremely low, and above all it produces a steady pressure which results in uniform operation of the cupola. It is therefore better adapted for foundry use than any of the other types in existence and the installation of electrically driven compressors in foundries is being proceeded with as rapidly as the business conditions warrant the adoption of new appliances.

How to Dry-Out Electrical Apparatus Which Has Been Submerged.

We all know how important it is for all of the moisture to be removed from the apparatus before putting same back into service. It is very essential to give a good deal of care to this work. There is no one better fitted to advise on this point than Mr. B. G. Lamme, chief engineer of the Westinghouse Electric &

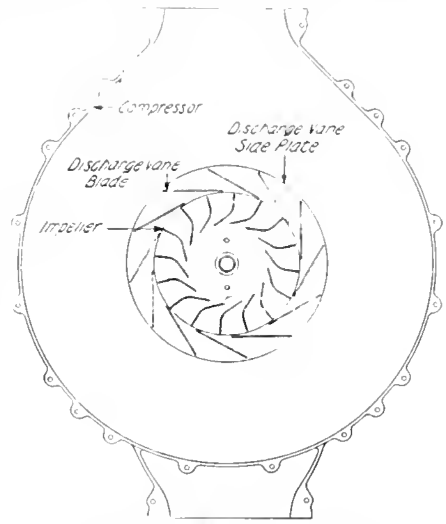
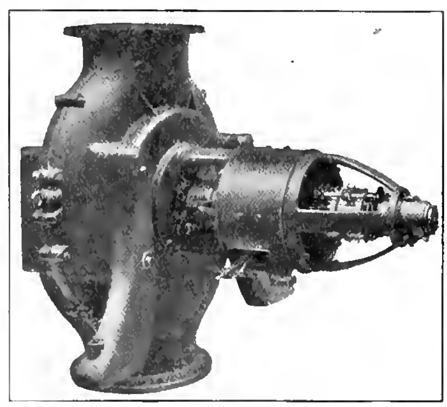


FIG. 3. A DIAGRAMMATIC SECTION OF A SINGLE STAGE CENTRIFUGAL COMPRESSOR.

Manufacturing Company. We summarize below the points brought out in a paper read by Mr. Lamme before the Association of Iron and Steel Electrical Engineers:

Experience has shown in some cases that a machine that has been flooded can be dried out with apparently no bad effects, while at times it is almost hopeless to save the machines. A good deal depends on the kind of insulation used in the make-up of the machine and the means for getting rid of the motor. If water has percolated into the coil, for instance, and has been trapped there, high internal temperature may simply vaporize the water without getting rid of it. If the insulation is porous, the water can be driven out.



A 16 OZ. CENTRIFUGAL COMPRESSOR DRIVEN BY A DIRECT-CONNECTED 30 H. P., 230 VOLT DIRECT-CURRENT MOTOR.

If the drying heat is applied from the outside, this heat may seal over the outside of the insulation before the water could evaporate. If, on the other hand, heat is applied on the inside and the heating is too rapid, vapor may be formed faster than it can pass through the pores of the insulation, damaging the same. The question that enters one's mind immediately is, how can heat be applied on the inside? We know that an electric current passing through a copper wire heats up the wire, the degree of heat depending on the size of wire and the amount of current passing through this wire. This fact is used for this drying-out process, and since it is not possible to connect up the machine to the full voltage on account of grounds which would immediately occur, it is put on what is termed "short circuit connection." The machine has the terminals connected together, and with this arrangement a very low voltage applied to the fields will cause a large current to flow in the armature and after a certain period all of the moisture will be driven out.

In drying out by the inside method it must be borne in mind that the temperatures at different parts of the machine may vary considerably; for instance the armature of a high voltage alternating current generator might be operated on a short circuit and the drying-out current may be so high that the center of the armature may be higher than 100 degs. C., the boiling point of water, while the ends may be 30 degs. cooler. It is very possible that the water will be turned to steam at the center part of the armature and this steam will be driven to the ends where it will condense.

One instance may be cited where, several weeks ago, the power house of the Westinghouse Electric & Manufacturing Company was flooded for several days and several large 2,200-volt turbo-generators were partly submerged. One of these machines was dried out on short circuit for about a week at a temperature of possibly 120 degs. C. inside the coil. At the end of this time no leak to ground showed and the machine was put in service. A few weeks afterward a short circuit occurred inside one of the coils, in the end winding. When dismantled this coil was found to be sopping wet in the end portion, although the buried part of the coil was fairly dry. The baking process had simply distilled the water from the center to the end parts. An examination of others of the submerged coils showed the same condition. It is possible that untaping of the end winding sufficiently to have allowed the escape of vapor would have caused this machine to dry out properly, but apparently this would not have been the case unless the end windings in themselves could have been brought up to a temperature considerably above 100 degs. C., and this might have meant 150 degs. C. in the buried portion. Such a temperature would probably have been injurious except to mica insulations, which did not happen to be on these machines. Furthermore, it is not always easy to get rid of moisture, even at 100 degs. C., with fibrous insulations. One very effective manner of doing so is by means of a vacuum. Experience has shown that if apparatus to be dried out is heated to the boiling point, in a vacuum, the moisture usually is removed very completely.

Electric Locomotives for Freight Service.

The Westinghouse Electric Company, of Pittsburgh, has just finished an order for the construction of twenty-one electrical locomotives for the Norfolk & Western Railway to be used in the handling of freight trains. That railway hauls a large volume of coal traffic over heavy grades and the electric locomotives will be employed upon this service. The calculations are that the electric locomotives will move the heavy freight at less cost than that incurred by the steam locomotives. It may be that the steam locomotive is reaching the end of its usefulness and that the Norfolk & Western are inserting the entering wedge. But the ultimate decision will again prove the survival of the fittest.

Indians Give Object Lessons.

About the last place the ordinary investigator would look for lessons in political economy would be among the native tribes of South American States, but it appears that Col. Roosevelt has there found what many people will consider a good object lesson in social economy.

Writing from the city of Cordoba at the foot of the Andes, he says "that the Argentines are thoroughly awake to the need of having small landowners, and also that they have no faith whatsoever in any of the theories that would abolish ownership in property, or even ownership in land." Then he continues:

"The worst obstruction to civilizing the Indian is the fact that the Indian actually practices the theories of certain advanced Socialists. The Indians of the Chaco, in practice, have no personal property. The result is that they are all kept permanently at the level of the shiftless, the idle and the incompetent. In practice it proves to be impossible to elevate them until they are given the chance to have personal property, which is not to be shared with the shiftless and idle. Among these Indians applied socialism has simply meant that any property acquired by anybody is shared with the worthless members of the tribe. The result has been the positive refusal of the thrifty and far-sighted to go into the business of accumulating goods for their brothers."

Close Call in Water.

Speaking of the narrow escapes that railway men encounter in following their calling our chief related particulars of an experience that few people pass through and remain to tell the tale. He said: "One time I was attached to a civil engineer's corps which was locating a narrow gauge railway in Wisconsin. Part of the summer we were stationed at Marysville, a small village on the Rock River. Not far from the village in a solitary woodland was a deep pool on the river where water lilies grew profusely. The chief engineer, Eugene Wiley, had his wife staying at the hotel. One day she mentioned in my hearing the wish to possess a bunch of the lilies on the Rock River, and I made up my mind to gratify her desire.

"A few evenings afterwards I went to the Pool, as they called the place, and found that all the lilies within easy wading reach had been gathered by the natives. All the good flowers were in deep water. Nothing discouraged I took off my clothes and swam into the midst of the lilies and proceeded to tear off a good bunch, swimming about after the finest specimens. On concluding that I had all the flowers wanted, I began to swim ashore, when, to my horror, I found that some of the long lily roots had wound themselves around one of my feet, forming a knot that held me fast. I was securely anchored in that deep pool. No boat was near and the chances for help were very remote.

"On realizing my position I was dreadfully panic stricken at first, and curiously enough remembered accounts my father had given me of several people of our name who had been drowned in the Caledonian Canal, and his injunction, 'avoid the water, laddie, and ye'll no be drowned.'

"After a few minutes of panic and violent tearing of the weeds I managed to calm myself sufficiently to consider what means there were for escape. I made several attempts to reach the knot that bound my foot which ended in the swallowing of water. Then a plan came to my mind. I swam quietly for a few minutes to regain breath, filled my lungs with air, then pulled myself to the bottom where I sat and with both hands untied the knot that was holding me. It took only a few seconds, but it seemed half a life time. When I got back to the surface of the water free, I permitted myself to float on my back long enough to regain strength, then I swam about and collected the flowers, which had floated away.

"Between railway and steamer experience, I have had several narrow escapes, from injury and death, but that incident in the Rock River of Wisconsin has made the strongest impression, I think it was the closest call and is not likely to be forgotten."

What Is Hardness?

THE DIFFICULTIES IN ASCERTAINING ITS PROPERTIES AND PECULIARITIES.

A correspondent in the London "Engineering" has an interesting article on the above subject from which we quote the following: "Testing of hardness is full of difficulties, the reason being that the word is used to cover a number of very different properties in materials.

"As a matter of proof for these different properties, the relation of the resistance to cutting or machining is discussed. The writer goes on to say that different hardness-testing instruments show different properties. The scratch test, according to him, measures resistance to scratching, not necessarily hardness. The scleroscope, which depends upon the principle of the rebound of a small diamond-face drop-hammer after causing a permanent set in the metal after dropping from a certain height, he says 'measures mainly what might be called bounceability,' substantiating his claim by the fact that india rubber, wood, and brass can cause a higher rebound than soft steel, while the Brinell machine measures the resistance to deformation. This, he considers, is the most correct test, although he does not claim that the test will show resistance to cutting in all materials.

"Let us first ascertain the relation between hardness and resistance to cutting. Hardness at the present time is generally understood to be a state of rigidness in a body which imparts to it the power to resist penetration and necessarily also deformation. Hardness in metals is much like the integrity of their melting-points, when pure. Fusion, then, always occurs at a fixed and known temperature. This will, however, change with the addition of impurities, or by alloying with such metals as may have a higher or lower melting-point. The tendency, then, is for a mutual adjustment between the two, so with the hardness of the metal in relation to its resistance to cutting or machining. A pure metal will show resistance to machining directly in proportion to the increase of hardness.

"In dealing with alloys, complications necessarily arise, yet a simple rule holds good. The power required to remove chips will depend upon the tensile strength which is developed by any alloy. This is also indicated approximately by the hardness reading. Wear of the tool here is quite another thing, for this depends upon the hardness of the hardest particles in that alloy. The cutting-tool must scrape against these, which are therefore determining factors from the standpoint of tool wear.

"Let us first consider mild-carbon steel. This, of course, is an alloy of carbon and iron. Carbon can only combine with iron to form a carbide, Ec3C, or cementite, which is a definite compound of considerable hardness, and has a carbon content of 6.67 per cent. Pure iron then acquires an affinity for this carbide, so that if the total carbon is very low, it appears as a network of mere streaks. These streaks become more numerous as the carbon content increases. Hence, in machining mild steel, the tool is obliged to overcome the tensile strength of the iron and carbon alloy; while the edge, in scraping against the microscopic streaks of hard carbide, will be worn in proportion to the number of these that are contained in the steel. The wear of the tool is then almost directly in proportion to the total carbon content, if it is in the annealed condition, while the power required to remove the chips, as before stated, may be in proportion to the tensile strength or true physical hardness.

"A very interesting example illustrating this point is the resistance to cutting offered by high-speed steel, which has usually a low carbon content, but yet a high tensile strength, and, therefore, high hardness reading. The tungsten and chromium with which the iron is alloyed appear to impart hardness, and, therefore, strength, without the formation of gritty material, such as carbide or iron is, for, as we have seen before, this contains 6.67 per cent. of carbon. High-speed steel thus may be 50 per cent. harder than the carbon steel in the annealed state, and while it may take more power to cut, will not show nearly so much wear on the tool, just because the carbon content is lower, the number of carbide grains being less. It is said that these grains are as hard as hardened high-carbon steel; in fact, hard enough to scratch feldspar.

"Another illustration of tool failures due to wear, independent of the hardness of the material, is found in the working of wrought iron containing slag grains. A drill may keep going all day without resharpening so long as no slag is encountered; while, on the other hand, it may fail at once if slag is struck, for this impurity is much harder than any hardened steel. It has been found that in connection with cast iron, silicon, which readily combines with iron, and is then easily cut, may be oxidized during the process of melting, and thus turn into particles of silica or stone. These do not impart greater strength or hardness to the iron, for the mixture is purely mechanical; but when an attempt is made to cut the iron having such impurities, the power required to do this is equal to the hardness of the iron, while the wear on the tool will be in direct proportion to the amount of silica or grit it contains.

"Another very interesting illustration of this phenomenon is seen in manganese steel. This material usually shows a high resistance to wear at a low physical hardness, and this is evidently due to the fact that it contains particles of great hardness suspended in a cement medium quite soft and ductile. Consequently, such steel cannot be machined by any scraping action. This is because the hard particles, being harder than the tool, quickly scrape off the edge. A cold chisel, however, which has its scraping action reduced to a minimum, will easily cut into manganese steel, the resistance of which is quite exactly in proportion to its physical hardness. This phenomenon teaches a very valuable lesson, and shows how important methods of cutting are with regard to action, shape, and clearance of the tool.

"It is needless to discuss here the effect of speed, where the principal destructive factor is heat. The theory of hardness has been rather well explained under Professor Howe's analogy of the brick wall, where cement is used to unite the bricks on the one hand, while on the other no cement is used, the bricks being merely piled up to form a wall. The bricks in each wall are of the same hardness. The wall with the cement, which combines the bricks into one unitary mass, is capable of resisting deformation and penetration, and would therefore be considered a hard body, while the one without the cement, under the same mechanical forces, would collapse; therefore it is incapable of resisting penetration and deformation; and although its grains or particles are just as hard, it would be said to have a low physical hardness. We have seen that the cement medium in a body, therefore, is just as important as the particles which it unites.

"Under ordinary conditions, the rebound from such very hard materials is less than from the height it falls, because of the resistance of air and mechanical friction; and while the falling body keeps vibrating for a considerable time, the energy of motion is gradually converted into heat due to said mechanical and air friction.

"Naturally, since the law of conservation of energy is so extremely exact and persistent, it would necessarily follow that the slightest deformation that can be caused between these colliding bodies will instantaneously detract from the rebounding effort, because of the work that had been done, until at last, when a soft metal, such as lead, is struck, practically all the energy of motion is converted into work, and the most insignificant rebound occurs. The scleroscope, therefore, is an instrument of strictly scientific origin. It obeys the laws of physics, and is deliberately designed toward that end. A properly-conducted hardness test by any correctly-designed instrument, like anything else, must necessarily become valuable, and more and more indispensable, as we learn not to waste time expecting the unreasonable."

Items of Personal Interest

Mr. R. Gardner has been appointed locomotive foreman of the Grand Trunk, with office at Island Pond, Vt.

Mr. J. J. Stahl has been appointed locomotive foreman of the Great Northern, with office at Rockford, N. D.

Mr. F. N. Norman has been appointed master mechanic of the Marshall & East Texas, with office at Marshall, Tex.

Mr. F. E. Wolfe has been appointed locomotive foreman of the Chicago Great Western, with office at Hayfield, Minn.

Mr. N. H. Hauser has been appointed mechanical engineer of the Chicago & Eastern Illinois, with office at Danville.

Mr. P. O. Sechrist has been appointed master mechanic of the Louisville & Nashville, with office at Nashville, Tenn.

Mr. J. E. Giles has been appointed foreman of locomotive repairs of the Pacific Great Eastern, with office at Squamish, B. C.

Mr. F. L. Fox has been appointed general foreman of the car department of the Pere Marquette, with office at Detroit, Mich.

Mr. N. S. Moseley has been appointed mechanical engineer of the Carolina, Clinchfield & Ohio, with office at Erwin, Tenn.

Mr. W. R. Harlan, oil burning inspector of the Southern Pacific, has had his office changed from Sparks, Nev., to Sacramento, Cal.

Mr. O. E. Linn has been appointed road foreman of engines of the Vandalia, with office at Decatur, Ill., succeeding Mr. B. C. Cooper.

Mr. C. Sonburg has been appointed general foreman of the Pere Marquette, with office at Chicago, Ill., succeeding Mr. J. J. Deitche.

Mr. D. Swineford has been appointed general foreman of the Detroit, Toledo & Ironton at Delray, Mich., succeeding Mr. B. Ferris.

Mr. J. E. Gogle has been appointed master mechanic of the Fourche River Valley & Indian Territory, with office at Bigelow, Ark.

Mr. J. S. Taylor has been appointed master car builder of the Meridian & Memphis, with office at Meridian, succeeding Mr. J. A. Jones.

Mr. A. L. Moler has been appointed traveling engineer of the Bangor & Aroostook, with office at Derby, Me., succeeding Mr. H. P. Roby.

Mr. A. Sturrock has been appointed district master mechanic of the Canadian Pacific, with office at Nelson, B. C., succeeding Mr. A. Mallinson.

Mr. J. Strum has been appointed road foreman of engines of the Southern Pacific, with office at Sacramento, Ca., succeeding Mr. C. R. Petrie.

Mr. W. H. Haskins has been appointed general foreman of the Pere Marquette, with office at Benton Harbor, Mich., succeeding Mr. U. S. Wilson.

Mr. E. A. Everhart has been appointed master mechanic of the Charles City Western, with office at Charles City, Ia., succeeding Mr. A. L. Ellis.

Mr. H. H. Jones has been appointed master mechanic of the Colorado & Wyoming, with office at Segundo, Colo., succeeding Mr. J. A. Owen.

Mr. W. F. Weigman has been appointed general foreman of the car department on the Charleston & Western Carolina, with office at Augusta, Ga.

Mr. J. A. Hannigan has been appointed general foreman of the Detroit, Toledo & Ironton, with office at Springfield, Ohio, succeeding Mr. W. J. Davis.

Mr. Frank Aitken has been appointed master mechanic of the Pere Marquette, with office at Grand Rapids, Mich., succeeding Mr. S. A. Chamberlain.

Mr. Harry M. Muchmore has been appointed division foreman of the Atchison, Topeka & Santa Fe, with office at Deeming, N. M., succeeding Mr. L. Stowell.

Mr. J. C. Rhodes, formerly road foreman of engines of the Chicago, Rock Island & Pacific, at Valley Junction, Ia., has been transferred to Des Moines, Ia.

Mr. E. H. Hartenstein has been appointed road foreman of engines of the Chicago & Alton, with office at Bloomington, Ill., succeeding Mr. W. H. Naylor.

Mr. W. E. Hayward, formerly roundhouse foreman of the Canadian Pacific at Vancouver, B. C., has been appointed night roundhouse foreman at Alyth, Calgary, Alta.

Mr. G. F. Burgess, formerly road foreman of engines of the Canadian Pacific at McLeod, Alta., has been transferred to Medicine Hat, Alta., succeeding Mr. E. J. Lemieux.

Mr. E. O. Griffin, formerly general fuel and supply agent of the International & Great Northern, has been appointed purchasing agent on the same road, with office at Houston, Tex.

R. Harvey White, southern representative of the Chicago Railway Signal & Supply Company, Chicago, has been promoted to the position of signal engineer of that company.

Mr. E. J. Lemieux, formerly road foreman of engines of the Canadian Pacific at Medicine Hat, Alta., has been appointed district master mechanic in the same road at Lethbridge, Alta.

Mr. G. Kehler has been appointed general foreman of the motive power department of the Delaware, Lackawanna & Western, with office at Elmira, N. Y., succeeding Mr. T. F. Perkinson.

Mr. J. Markey, formerly master mechanic of the middle division of the Grand Trunk at Toronto, Ont., has been appointed master mechanic of the Ontario lines of the same road, with office at Toronto.

Mr. H. F. Staley, formerly master mechanic of the Carolina, Clinchfield & Ohio at Erwin, Tenn., has been appointed master mechanic of the Boyne City, Gaylord & Alpena, with office at Boyne City, Mich.

Mr. H. B. Hayes, formerly master mechanic of the Cincinnati, New Orleans & Texas Pacific at Somerset, Ky., has been appointed to a similar position on the Alabama Great Southern, with office at Birmingham, Ala.

Mr. C. J. Bodemer has been appointed master mechanic of the Louisville & Nashville, with office at New Decatur, Ala., succeeding Mr. J. J. Sullivan, now superintendent of machinery of the Nashville, Chattanooga & St. Louis.

Mr. Benjamin S. Hinckley, purchasing agent of the Boston & Maine, with office at North Station, Boston, Mass., has now charge of all purchases of material on that road, the office of manager of purchases having been abolished.

J. A. Smythe has been appointed boiler expert of the Lukens Iron & Steel Co., and the Jacobs-Shupert U. S. Firebox Co., with headquarters at Coatesville, Pa. Mr. Smythe was formerly with the Parkesburg Iron Co., Parkesburg, Pa.

M. Wuerpel, assistant general manager of the General Railway Signal Company, has been appointed assistant to the president of that company. S. G. Johnson, who was recently elected vice-president, will be in full charge of the sales department, with headquarters at Rochester, N. Y. A department of publicity and education has been created and H. M. Sperry has been appointed the manager.

Colonel H. G. Prout has been elected president of the Hall Switch & Signal Company, and William P. Hall is now vice-president and chairman of the executive committee. W. J. Gillingham has been appointed general sales manager, with headquarters at New York City. W. A. Peddle has been appointed acting chief engineer, and W. H. Lane, chief engineer, has been granted leave of absence on account of ill health. Colonel Prout in July last resigned as president of the Union Switch & Signal Company.

E. H. McCann has been appointed master mechanic of the San Antonio, Uvalde & Gulf, with headquarters at Pleasanton, Tex., succeeding J. H. Ruxton, resigned.

Mr. H. C. Hequembourg has resigned as general purchasing agent of the American Locomotive Company, and a successor will not be appointed at present. Meanwhile the purchasing and storekeeping departments will be under the jurisdiction of Mr. Leigh, vice-president.

Mr. Charles Hyland, formerly foreman boiler maker, in charge of the Michigan Central Railroad shops at Jackson, has resigned to accept the position of boiler expert with the Flannery Bolt Company, of Pittsburgh, well known manufacturers of the Tate flexible staybolts. Mr. Hyland succeeds Mr. Tom R. Davis, deceased.

Mr. George Boume, president of the Locomotive Superheater Company, sailed for Europe on the *Ryndham* on November 17, on a business trip through Europe. He expects to be absent three or four months. He also expects some little delays in passing through northern Europe, and it will be worth while listening to his experiences in the war zone when he returns. The war clouds may roll away, but the superheater has come to stay.

Mr. George I. Graham, formerly general foreman of the Delaware & Hudson at Wilkesbarre, Pa., has been appointed master mechanic of the Pennsylvania division of the same road at Carbondale, Pa., succeeding Mr. J. J. Reid, who has been transferred to Onconto, N. Y. Mr. Graham is a son of the late Mr. Charles Graham, for many years master mechanic on the Lackawanna at Scranton, Pa. He is a graduate of Lehigh University and a mechanical engineer of wide experience in railroad work.

Mr. Walter T. Spencer has been appointed superintendent of the Old Colony division of the New Haven, succeeding Mr. H. C. Oviatt, who has been promoted. Mr. Spencer is a graduate of Sheffield Scientific School of Yale University. He began railroad work on the New Haven as a rodman in 1890. In 1902 he was promoted to transit man, and in 1893 was made a division engineer. In September, 1914, he was transferred from the engineering to the operating department of the road and made trainmaster. His headquarters will be at Taunton, Mass.

Mr. W. D. Robb, superintendent of motive power of the Grand Trunk, announces the following appointments: Mr. T. McHattie, formerly master mechanic at Montreal, to the position of master mechanic of the Eastern Lines; Mr. W. H. Sample, formerly master mechanic at Ottawa, to be master mechanic of the Western Lines; Mr. J. Markey, formerly master mechanic at Allandale, to be master mechanic of the Ontario Lines; Mr. J. R. Donnelly appointed assistant master mechanic of the Ontario Lines, with headquarters at Allandale, and the titles of master mechanic of the Northern Division and Ottawa Division are abolished.

Mr. Marcus A. Dow, head of the Safety Department of the New York Central Lines, and who has produced the first moving picture play in relation to the safety movement, has been twelve years in the service of the New York Central. He was district claim agent for some time at Oswego, N. Y., and also at Corning, N. Y., and latterly in a similar position at Buffalo, N. Y. Mr. Dow was over ten years engaged in investigating personal injury cases and had excellent opportunities to study accident prevention. He was placed in charge of the Safety Department of all the New York Central Lines, with offices in New York, in March, 1913. Under his able management the department is one of the most progressive organizations of its kind in America. The Safety Exhibit Car introduced by him has attracted wide attention, while the policy of requiring employees to receive safety instructions during working hours is the outcome of his endeavors. The production of a moving picture drama, and which we describe elsewhere in our pages, bids fair to meet with much popular favor and is likely to be the forerunner of a new and impressive method of emphasizing the necessity of the Safety First movement.

MARCUS A. DOW.

Obituary.

WILLIAM E. MAGRAW.

The sudden death of Mr. William E. Magraw, of Chicago, Ill., is announced as we proceed to press. Mr. Magraw was well known in railroad circles as the president and treasurer of the Railway List Company, the publishers of our esteemed contemporary, the *Railway Master Mechanic*, and other publications.

Development of Electricity.

At a meeting of the Franklin Institute, Philadelphia, Dr. Charles F. Brush remarked: "In speaking of the early history of electrical development in this country I cannot avoid being personal to some extent, and I hope you will pardon that, because at the time I became interested in the subject it was not much of a subject, and there were very few thinking of it, and any one who happened to take an interest in it was conspicuous for that reason, and could not say anything about it without being more or less personal.

"As this is partly a function of the Franklin Institute, too much cannot be said for that venerable and splendid institution. I think we may safely say that, in a way, the electrical industries as we know them today were born and fostered in that institution, and I have particularly in mind the year 1877, when the Institute became ambitious to own a dynamo electric machine, a thing very rare in those days, and invited such makers as there were in the world to send in their apparatus and compete for the sale.

"Professors Thomson and Houston, if I remember correctly, took entire charge of the electrical measurements, which extended over a period of several weeks, and the contest excited in Philadelphia great interest, and I think it may be justly said that the interest then aroused here and elsewhere indirectly started the growth of our great industries.

"That was in the summer or autumn of 1877. In the spring of 1878 there began to be some little indications of commercial activity in the field of electric lighting, and by the summer or autumn of 1878 there was considerable activity in this field; and it is interesting to note that a Philadelphian, Mr. John Wanamaker, lighted his great store almost wholly with electric arc lights. He had a plant by the autumn of that year, consisting, I think, of 20 arc lights of about the present size. That was far and away the largest electric lighting plant in the world, and it was in Philadelphia.

"Of course, some humorous things occurred in the early days of the industry. I remember one occasion when a small electric light plant, perhaps a 20-ampere light—which was large for those days—was shipped to Cincinnati by the then Telegraph Supply Company, to Dr. Longworth, an enterprising scientist of that city, and I went there to show him how to run the lamp. It was exhibited in front of the building in which he had his office, and, of course, attracted a great deal of attention. On the first evening when it was shown a large crowd of the natives gathered in front of his establishment, and you could hear various exclamations of delight. Here and there in the crowd you could hear some one person deliver-

ing a little impromptu lecture on the electric light, and he would have quite a hearing. You may, some of you, recall that in these early days, the lamp that first made its appearance had a large solenoid at the top, through which ran a rod which carried the carbon. One man who had collected quite an audience pointed to the solenoid and said, 'Gentlemen, that is the can that holds the oil.' The lamp had two rods at the sides. He pointed to them and said, 'Those are the tubes which convey the oil from the can to the lamp.' He created quite a sensation and his hearers went away feeling that they knew a whole lot about the electric light, although the speaker had said nothing about it at all.

"In the summer of that year an exhibition was held at the Union Steel Screw Works in Cleveland. A dynamo was exhibited there which operated four electric lights on separate circuits with the non-series lamps, and quite a large company of invited citizens were present to witness the exhibition. One of the most prominent of the old Clevelanders seemed to be greatly interested, and he pointed to the line wire between the lamps, which was bare copper then, and he asked me, 'How large is the hole in that little copper tube through which the electricity passes?' He was quite in earnest.

"The superintendent of the shop, one of those men who know everything, looked for five minutes, perhaps, at the dynamo. There was more or less sparking on the commutators, and then he was ready to tell me all about it. He said, 'The electricity in that thing is generated by that revolving business rubbing the air up against them iron blades'—he called them, meaning the pole shoes of the magnets—'just like you get sparks when you rub a cat's back.' I said this was a simple and beautiful theory, but it was not entirely right. However, that did not affect him at all. He said, 'It is perfectly clear; if you should run that thing in a vacuum, you would not get any electricity.' He seemed to be so happy in his state of mind, in his theory, that nothing further was said about it.

"Late in the fall of 1878 there appeared the first device known as the series arc lamp, and I think we may call that year, 1878, the banner year in the early history of the electrical industry, because it was that device which first made electric lighting from central stations commercially possible; I think we may regard that year as marking the birth of the electric lighting industry. Prior to that time the development of electric lighting was slow, but after that it was very rapid, and as early as the spring of 1879, the public square, a little park of about ten acres, in Cleveland, was lighted with twelve series arc lamps, and it has been lighted electrically ever since. I am quite sure that was the first electric street lighting in the world, on a commercial basis. And that is not so very long ago—that is, it does not seem so to me, but it will to some of you. I was introduced a week or ten days ago at the opening of an electrical exhibition in Cleveland by a chairman who said he had the pleasure of introducing a gentleman who was familiar with the electrical industry in 1779. I promptly claimed an alibi before any one had a chance of asking me if I remembered the true inwardness of the Washington hatchet story current at that time. I got in ahead of them; I wasn't asked.

"It is interesting to reflect that even at this time, 1879, when the industry had really made a start, we had no shop instruments such as we have now—no ammeters, voltmeters, and so on. We had to guess at almost everything. It was about 1881 when we first had instruments of that nature.

"Many references have been made to the electrical exposition that we are celebrating today, but it was my good fortune, my privilege, to attend an electrical exposition in Paris in 1881, which was perhaps the first of its kind in the world. It was held in the great Palace of Industry there, and was considered a great affair at the time, and it was. But while that was very early, I think we may say that most of the seeds of the great industries which have developed since, were there. There were perhaps 100 arc lights and about as many incandescent lights, and all were used to light that great building, and it was thought they did it splendidly. And there were various types of dynamos, both alternating current and direct, and a few motors. And there was the telephone, of course. That was just beginning to attract great attention, and there was a crude form of storage battery which excited very much interest. There was a real trolley car, which ran a few hundred feet back and forth outside the building—when the electrical conditions were propitious—which was not very often—and it was always crowded with passengers, many of whom had waited a long time for a chance to get aboard—quite like the present-time practice.

"Going back a moment to the year 1878, which, as I said, was the birth year of our great industries, the year from which they started a vigorous growth, I imagine there was not invested in the whole of the electrical industries more than two or three hundred thousand dollars. I think that would be ample to represent them all, outside of the telegraph. In 1905, which was 27 years later, I had occasion to collect some data as to the amount of capital invested in the electrical industries at that time, and to my surprise I found it to be not less than four thousand million dollars in this country alone; that is about one hundred and fifty million dollars a year on an average, for the 27 years, or half a million dollars for every working day during the 27 years. Now, in the nine years since 1905, I imagine the investment has been, on an average, three times as rapid. I think we are within bounds in estimating that for the last nine years there has been something like a million and a half dollars of new capital going into the electrical industries every working day of that period; and the end, gentlemen, is nowhere in sight."

Perils of Flagging.

At a dinner of the Railway Guild, the proper practice of flagging under Rule 99 was discussed and a witty member presented the following story in rhyme:

A serious trouble on everyone's line
Is how to enforce rule ninety and nine.
When a train makes a stop at an unwonted place,
The flagman must go back in every case;
He must stay with his flag, nor come back at all,
Until from the whistle shall sound his recall.
One case I have heard of, which raises a doubt:
A train had been stopped, the flagman sent out;
Back to the rear the man promptly went;
When with growlings and snarlings of evil intent,
From a dense woods near by came a big hungry bear,
To assist in the flagging and take up his fare.
If the man's with the right sense of duty imbued,
Must he follow the rule, stay there and be chewed?
If he did it was likely that nought but his boots
Would be there to come in, in response to four toots.
So he searched the rules through remarkably fast,
No solution appeared, 'til he came to the last.
Then the answer he found in rule one twenty-one,
Which clearly defines the right thing to be done.
"If the case is uncertain or some doubt exists,
Take the safe course and do not run risks."
So heartily thanking the man who compiled that,
He turned on his tracks and ran back as a wild cat.

Sticking By Him.

Traveler—I have time for a drink?

Conductor—Yes, sir.

Traveler—Can you give me a guarantee that the train won't start?

Conductor—Yes. I'll take one with you!

RAILROAD NOTES.

The Boston Elevated is in the market for one hundred cars.

The Chilean Government is said to be in the market for 250 freight cars.

The Northwestern Pacific will erect a depot, roundhouse and shops at Willits, Cal.

The Southern has ordered 4,400 tons of rails from the Pennsylvania Steel Company.

The Louisville & Nashville has ordered eight coaches from the American Car & Foundry Co.

The Georgia has ordered three Mikado locomotives from the Lima Locomotive Corporation.

The Pere Marquette has placed an order for 200 underframes with the Pressed Steel Car Co.

The Maine Central is said to have ordered seven locomotives from the American Locomotive Co.

The Central Vermont has ordered three ten-wheel locomotives from the American Locomotive Co.

The Russian Government Railways are said to be considering the purchase of 100 additional locomotives.

The Illinois Central it is said, will build a machine shop, turntable and roundhouse at Dyersburg, Tenn.

The Northern Pacific has ordered 750 steel underframes from the Haskell & Barker Car Company.

The Russian Government Railways, it is said, ordered 30 locomotives from the Baldwin Locomotive Works.

The Baldwin Locomotive Works has increased the working time at its Eddystone, Pa., plant to five days a week.

The New York, New Haven & Hartford, it is reported, will enter the market for a number of steel passenger cars.

The Intercolonial has received six consolidation and four switching locomotives from the Canadian Allis-Chalmers Co.

The Southern Pacific has ordered 24 interurban cars from the Pressed Steel Car Company for use on the Pacific Electric.

The Northern Pacific has ordered 21 standard sleepers from the Pullman Company and is receiving bids on 95 other cars.

The Baltimore & Ohio has ordered 1,000 tons of rails from the Carnegie Steel Company and 1,200 tons from the Illinois Steel Company.

The Southern has completed installation of an automatic electric block signal system between Knoxville and Morristown, Tenn.

The Oregon-Washington R. R. & Navigation Co. will build shops, engine houses, turntable, power house, coaling dock, etc., at Spokane, Wash.

The Buffalo, Rochester & Pittsburg has placed in service a new block system between Buffalo and Salamanca, N. Y., a distance of 63 miles.

The Cleveland, Cincinnati, Chicago & St. Louis has placed an order for ten switching locomotives with the American Locomotive Company.

The National Transcontinental has ordered 250 50-ton freight cars of the Eastern Car Company and 200 50-ton flat cars of the Nova-Scotia Car Works.

The Louisville & Nashville has placed a contract with Rommel Brothers, Louisville, Ky., for roundhouse and repair shops in the yard at Lexington, Ky.

The Southern has nearly completed the installation of a modern automatic block signal system between Amherst and Whittles, Va., and between Atlanta and New Holland, Ga.

The Louisville & Nashville has ordered eight coaches, six baggage cars, four combination baggage and mail cars and a dining car body from the American Car and Foundry Company.

The Chicago, Milwaukee & St. Paul has ordered twelve 260-ton electric locomotives from the General Electric Co. to be used on the Rocky Mountain division which is to be electrified.

The Nashville, Chattanooga & St. Louis has ordered 500 freight cars from the American Car & Foundry Company, and the same number from the Mount Vernon Car Manufacturing Company.

The Chicago & Alton is building an eight-stall roundhouse and a small machine shop and power house at Brighton Park, Ill. The buildings are of concrete and brick construction and the work is being done by the company's own forces.

The Southern will start work at once on new engine terminal facilities at Denverside, near East St. Louis, Ill., at a cost of about $275,000, and is asking for bids for the construction of an 18-stall roundhouse, shops and other buildings.

The Detroit, Toledo & Ironton will build a frame five-stall roundhouse with concrete engine pits, and a frame freight house 20 feet by 90 feet in area, and with a platform surface of 2,500 square feet at Delray, Mich. The work will be done by the company's forces.

The Grand Trunk Pacific has given a contract to Carter, Halls & Allinger, Winnipeg, Man., it is said, for constructing terminals at Prince George, at Endako, at Smithers and at Pacific. This will include roundhouses, machine shops and other railway buildings.

Survey work along the proposed Peace River & Athabasca will be completed this autumn. The route, which includes various waterways, rivers and lakes, electric and steam roads, aggregating many hundreds of miles, will open up resourceful sections of country, especially in British Columbia.

Dixon's Boiler Graphite.

The accompanying illustration shows a barrel of Dixon's Boiler Graphite in the form of a mailing card which the Joseph Dixon Crucible Company of Jersey City, N. J., is using to introduce this product to engineers and others interested in cleaner boilers. The card is printed in two colors and on the inside calls attention to the fact that for nearly four score and ten years, the company has had at its command, all forms and grades of

FORM OF DIXON CRUCIBLE COMPANY'S NEW MAILING CARD.

graphite and therefore has no incentive to use or recommend other than the correct grade of Dixon's Boiler Graphite. D. B. G. is said to reduce fuel consumption, prevent the hardening of scale, give to the surface of the boilers, a smooth polish, prevent pitting and make the removal of scale easy by a gentle, mechanical action. The reverse fold forms a return card bearing an invitation to write for the Dixon booklet "Graphite For The Boiler."

Steel Letter Stamping Dies.

Noble & Westbrook, of Hartford, Conn., a well-known firm to the machinery trade as a maker of steel letter stamping dies, is rapidly coming into popular favor with a number of the leading railroad companies, and has just completed a large order for the Pennsylvania and has done a considerable amount of work for the Lackawanna. The merit of the company's work has been well known and highly appreciated among machine and tool

STEEL LETTER STAMPING DIE.

makers for a number of years, but it is only recently that the company's fine products are being sought for by railroad men, and a large increase in the use of the company's dies and stamps in railroad shops may be confidently looked for in the near future.

The simplest forms of steel letter stamping dies are, of course, the single letters and figures that are in everyday use in the machine shop. From the single letter to the stamping die and from the hand-hammer to the power press is but a step in the course of evolution, and the variety of forms of dies and presses which has been produced by the firm's clever mechanicians are adapted to every variety of work. The ordinary hand stamps, as shown in the accompanying illustration, are forged from the best of English steel and are heated in charcoal and drawn in oil, thus insuring the best temper known for this work.

It need hardly be added that a neat mark is desirable and adds to the appearance of all furnished work, and is a feature that should not be ignored. The best is called for in all modern work and antiquated and clumsy designs are rapidly being displaced by improved forms and finish. The expert engravers familiar with stamp and die cutting employed by the company are not surpassed in their special line of work, and samples or sketches of work with complete details will be furnished on application.

Books, Bulletins, Catalogues, Etc.

The Development of British Locomotive Design.

This is a complete work of reference on the details of locomotives, early and modern, by E. L. Ahrons, M. E. It is fully illustrated with drawings and photographs. A portion of the book originally appeared in *The Locomotive Magazine*, but the larger portion has been rewritten and much new matter added. The details of the modern locomotive have received special attention, and many illustrations of present day practice have been given. The style is simple and direct and in point of completeness it embraces everything known in locomotive practice up to the present day, and is altogether a valuable contribution to the railroad literature of our time. The drawings, photographs and plates have the merit of clearness; the letter press and binding are excellent. The book is published by the Locomotive Publishing Company, London, England, and American orders will be filled by the Angus Sinclair Company, 114 Liberty street, New York. Price, two dollars.

Samples of Coal.

The United States Bureau of Mines has just issued a small edition of Bulletin 85, "Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1911 to 1913," by Arno C. Fieldner, Howard I. Smith, Albert H. Fay and Samuel Sanford. The present bulletin presents analyses and descriptions of samples of coal collected from many mines throughout the entire country. In order that the material in this bulletin may be made to supplement that presented in Bulletin 22, "Analyses of Coals in the United States," the same plan of geographical classification has been followed, the analyses and descriptions of the samples being grouped in alphabetical order according to the State, county and town near which the mines or prospects sampled are situated. Bulletin 22 was said to be the most comprehensive publication ever issued on the coals of the United States and the new bulletin is an extension of that work. So great was the demand for Bulletin 22 that the free edition was exhausted a few weeks after its issuance. At the present time the only way to obtain a copy of Bulletin 22 is through the Superintendent of Documents, Government Printing Office, Washington, D. C., who sells the publication at eighty-five cents.

Engineering Congress.

The Committee of Management of the International Engineering Congress, whose headquarters are at the Foxcroft Building, San Francisco, has just issued a prospectus of the proposed proceedings of the congress to be held September 20-25, 1915, at San Francisco. About 300 papers on various engineering subjects are expected to be presented, and the transactions will be published in 10 volumes of 500 pages each. Of special interest to railroad men will be Mechanical and Electrical Engineering, on which, there will be 33 topics discussed, including foundry practice; forging; equipment and processes for boiler shop work; equipment and processes for machine shop work; automatics; special processes for shaping and forming metals; high temperature flames; industrial management; safety; industrial museums; steam engine of 1915; steam turbine of 1915; steam boiler of 1915; internal combustion engine of 1915; motors of Diesel type; refrigeration; pneumatics; lubrication; power plant design; hydraulic and hydroelectric power; motor vehicles and tractors; correlation of magnetic and mechanical properties of steel; application of electricity to fabrication of metal structures and machines; economics of electric drive for shops; influence of electric drive on design of machine tools; electrolysis of engineering structures; industrial effect of low cost of electric energy; effect of hydroelectric power transmission on economic and social conditions.

Drill Chips.

Just as Cleveland twist drills hold a unique place in mechanical appliances so does *Drill Chips,* the company's monthly publication, hold a place of its own among trade publications. The editor is a philosophic wag with a double-cylindered imagination and a spiral fancy that revels in apt illustrations and fine similes. He is a poet in disguise. His pen is as sharp as a twist drill. He never wobbles, but goes straight through, the cutting edge of his polished pen leaving a smooth impression. He is one of the few writers that can mix complex machinery with profound philosophy, and as he untwists his flowing periods he never grows dull. Like the Cleveland twist drill he would be hard to beat.

The Evolution of Power.

The evolution of power on the Denver & Rio Grande Railroad from 1871 to the present year is superbly illustrated on two finely illuminated posters issued by the passenger department of the railroad. Beginning with an American type locomotive of the 3-ft. gauge type and weighing 12 tons, there are eight types, concluding with the Mallet type for mountain service, and weighing 250 tons. The combination is a striking example of the growth of railroad appliances in little over forty years. The length of the first

locomotive is 30 ft., that of the last being 101 ft. 6 ins. It is hardly to be imagined that this growth will continue, but, with several triplex compounds on the way and more coming, there is no reason to doubt but that a quadruplex will be climbing the hills before another decade is over. There seems to be no limit in point of size in the atmosphere of American enterprise, and the motto of the Rio Grande is "The best in the West."

Increased Railroad Rates.

The opening argument of the railroads in the five per cent. advance case, delivered before the Interstate Commerce Commission by Mr. George Stuart Paterson, general solicitor of the Pennsylvania Railroad, last month, is published in pamphlet form, and is a most convincing document. It shows that since last year the increase in total capital obligations on 35 systems amounts to 159 millions of dollars, with an increase of property investments of 249 millions. On the other hand, there is a decrease in revenues of 48 millions, and an increase in taxes of over 3 millions. The surplus of 76 millions in 1913 has disappeared and already there is a deficit of 8 millions in 1914. It is most unfortunate that the carriers should, while in such a condition of inherent weakness, be compelled to encounter a storm so serious as that which the European war has brought upon the world. A consideration of all the facts as presented by Mr. Paterson shows conclusively that the needs of the carriers can only be met practically by the remedy of a general advance in freight rates.

Against Self-Made Clothes.

Many men who have had to make their own way from a lowly condition in life to a prominent position have a silly pride in dressing so plainly that they are readily mistaken for mechanics whose life has been a constant struggle with poverty. Andrew Carnegie is a conspicuous exception in this respect. He is always tastefully dressed in well fitting clothes. Even on the golf links he is neat and tidily dressed in knickerbockers. The writer once commented to Mr. Carnegie on his well fitting clothes and received this reply: "Although I am a self-made man I have always been careful to keep people from thinking that I make my own clothes."

It is a false position to feel that you have to work. This is a slave's version. Always feel that you are to be congratulated on having good health and being able to work.

If you are running a train the track will never take you to the superintendent's office, if you are constantly in need of some one to superintend you.

Public Enemies.

If you build a line of railway, over hills
and barren lands,
Giving lucrative employment to about a
million hands;
If you cause a score of cities by your
right-of-way to rise,
Where there formerly was nothing but
some rattlesnakes and flies;
If when bringing kale to others, you acquire a little kale,
Then you've surely robbed the peepul and
you ought to be in jail.

If by planning and by toiling, you have
won some wealth and fame,
It will make no odds how squarely you
have played your little game;
Your success is proof sufficient that you
are a public foe—
You're a soulless malefactor, to the dump
you ought to go;
It's a crime for you to prosper where so
many others fail;
You have surely robbed the peepul, and
you ought to be in jail.

Be a chronic politician, deal in superheated air;
Roast the banks and money barons, there
is always safety there;
But to sound the note of business is a
crime so mean and base,
That a fellow guilty of it, ought to go and
hide his face.
Change the builders' song triumphant for
the politicians' wail,
Or we'll think you've robbed the peepul
and we'll pack you off to jail.

Yet He Answered All Right.

A young German was being tried in court, and the questioning by the lawyers on the opposite side began:

"Now, Muller, what do you do?"

"Ven?" asked the German.

"When you work, of course," said the lawyer.

"Vy, I vork——"

"I know," said the lawyer, "but what at?"

"At a bench."

"Oh, Lord!" groaned the lawyer, "where do you work at a bench?"

"In a vactory."

"What kind of a factory?"

"Brick."

"You make bricks?"

"No; de vactory is made of bricks."

"Now, Muller, listen," said the lawyer; "what do you make in that factory?"

"Eight tollars a veek."

"No, no! What does the factory make?"

"I dunno; a lot uv money, I tink."

The call for common sense, practical men was never so loud. An energetic, hard-working man without education is more valuable to himself and to others than the technically trained man without common sense.